TRANSACTIONS

OF THE

SAN DIEGO SOCIETY OF NATURAL HISTORY

VOLUME VIII, No. 20, pp. 185-276, figs. 1-112

A KEY TO THE RATTLESNAKES WITH SUMMARY OF CHARACTERISTICS

BY

LAURENCE M. KLAUBER

Curator of Reptiles and Amphibians, San Diego Society of Natural History

SAN DIEGO, CALIFORNIA

PRINTED FOR THE SOCIETY

DECEMBER 7, 1936

TABLE OF CONTENTS

A KEY TO THE RATTLESNAKES WITH SUMMARY OF CHARACTERISTICS

BY

Laurence M. Klauber

Curator of Reptiles and Amphibians, San Diego Society of Natural History

INTRODUCTION

The presentation of an identification key to the rattlesnakes appears desirable at this time since none is now available which incorporates the changes and additions resulting from recent taxonomic researches. The papers describing new subspecies are scattered in the literature and it would seem well to co-ordinate the results in a single publication in order that they will be more generally recognized by the nonspecialist in this field. Hence the publication of the key at this time, even though further changes resulting from investigations in taxonomy and nomenclature are to be expected in the future.

Recent researches in rattlesnake venoms have disclosed some rather surprising species differences both in toxicity and physiological effects. Differences in venom strength of an order of 60 to 1 have been indicated; and there appear to be differences in the relative proportions of hematoxins and neurotoxins. Under such circumstances, if our remedial technique is to be improved, it is important that species be differentiated in case reports. It is hoped that this key will serve a useful purpose in permitting physicians and others interested in the snake-bite problem to identify accurately the snake involved.

THE STATUS OF THE RATTLESNAKES

The following summary concerning the status of the rattlesnakes is presented to permit the non-herpetologist to orient himself with respect to the position of the group herein discussed.

Rattlesnakes comprise a number of species of venomous snakes belonging to the family *Crotalidae*. They are found only in the Western Hemisphere and reach their greatest profusion in the southwestern United States and northern Mexico. All rattlesnakes have at least one rattle* even when born, and the user of this key is presumed to be certain that he has a rattlesnake at hand, since the key is not intended to be of service in identifying other snakes, whether venomous or harmless.

Rattlesnakes and other members of the family *Crotalidae* are pit vipers, so called because of their possession of a sensory organ, probably auditory in purpose, in the form of a pit or deep depression, plainly visible on either side of the head below and back of the nostril (fig. 6).

* Of course occasionally a rattlesnake may lose the end of his tail through accident and with it his identifying rattles, which thereafter will not be regenerated. But the tail will remain only as a stump; no sharp-tailed snake is a rattlesnake in disguise, as a surprising number of people seem to think possible.

In this the members of this family *(Crotalidae)* differ from the Old World vipers of the family *Viperidae,* sometimes called the true vipers, which do not possess pits. The true vipers and pit vipers have this in common: the venom fangs are seated in a rotatable bone (the maxillary) whereby when not in use they lie folded back against the roof of the mouth, from which position they may, at will, be rotated forward and downward into the biting position perpendicular to the upper jaw. There are many forms of dangerously venomous snakes which are not vipers, including the cobras, mambas, coral snakes, etc.; these have shorter, permanently erect fangs, at the front of the upper jaw.

By no means all of the members of the family *Crotalidae* are rattlesnakes. The pit vipers of this family are divided into the following genera, of which only the first two are rattlers:

GENUS	COMMON NAME	CHARACTERISTICS	HABITAT
Crotalus	Rattlesnakes	Possess rattles; scales on crown.	North & South America
Sistrurus	Ground Rattlesnakes	Possess rattles; plates on crown.	North America
Bothrops	Neotropical Pit Vipers	Without rattles; scales on crown; large posterior subcaudals.	North & South America
Lachesis	Bushmaster	Without rattles; scales on crown; small posterior subcaudals	Central & South America
Trimeresurus	Asiatic Pit Vipers	Without rattles; scales on crown.	Asia
Agkistrodon	Moccasins	Without rattles; plates on crown.	North America; SE. Europe; Asia

Some herpetologists, feeling that the genera *Bothrops* and *Trimeresurus* are insufficiently distinct to warrant separation, combine them under the latter name.

The rattlesnakes comprise the most important group of venomous snakes to be found in the United States. The only dangerously venomous snakes occurring in this territory *except rattlesnakes* are the following:

Micrurus fulvius fulvius (Linné), 1766.

Southeastern Coral Snake.

North Carolina to southern Florida; westward and southward along the Gulf lowlands into Mexico; northward in the Mississippi Valley to Ohio and Indiana.

Micrurus fulvius barbouri Schmidt, 1928.
South Florida Coral Snake.
Extreme southern Florida.
Micruroides euryxanthus (Kennicott), 1860.
Sonoran Coral Snake.
Southern border of Arizona and New Mexico, and south into Mexico.
Agkistrodon mokasen mokasen Beauvois, 1799.
Eastern Copperhead.
Massachusetts west to Illinois and from these south to northern Florida and eastern Texas, including the intervening states.
Agkistrodon mokasen laticinctus Gloyd and Conant, 1934.
Broad-banded Copperhead.
Western and central Oklahoma southward to western and central Texas.
Agkistrodon piscivorus (Lacépède), 1789.
Water Moccasin
Virginia south throughout Florida, westward along the Gulf to the Rio Grande and north in the Mississippi Valley to Illinois.

Thus it will be seen that there are found in the United States four species (six subspecies) of venomous snakes other than rattlesnakes. It is true that there are other, moderately venomous snakes in the southwest, including certain species of the genera *Leptodeira* and *Trimorphodon*. However it is doubtful whether the bite of one of these would be dangerous to a human being. The fangs are in the back of the mouth and are grooved rather than hollow; they are therefore not mechanically well-designed to inject venom into a wound in a large animal, although no doubt effective in subduing such small prey as lizards.

The copperheads and moccasins, being pit vipers, can be readily recognized by the presence of the pit and by their possession of rotatable fangs in the front of the upper jaw. These criteria will serve to distinguish them from various harmless snakes with which they are often confused, particularly certain water snakes of the genus *Natrix*. The coral snakes, small inoffensive-appearing creatures, may in their turn be recognized by the arrangement of the rings of their pattern. The coral snakes are ringed with black, red, and yellow; and it is characteristic of them that there is always a yellow ring between successive red and black rings. This is different from the color sequence in various harmless forms which are often taken for coral snakes, such as certain king snakes of the genus *Lampropeltis*, and other snakes of the genera *Rhinocheilus, Sonora, Chilomeniscus,* and *Cemophora.*

The above remarks on the recognition of dangerous snakes apply only to the United States. In Mexico, and more especially in Central and South America, there are many more species of venomous snakes other than rattlesnakes; for the latter do not occupy the dominant position there which they do in our country. As we go southward we encounter an increasingly complex variety of coral snakes *(Micrurus)* and a bewildering array (possibly 50 forms) of pit vipers of the genus *Bothrops*,* to say

* One of the most important of these tropical pit vipers is the fer-de-lance, *Bothrops atrox*,

nothing of the bushmaster, *Lachesis muta,* and another moccasin, *Agkistrodon bilineatus.* Also in these areas various back-fanged snakes become so large that they may well be considered dangerous to man, although I have heard of no serious accidents from their bites. Thus it is not as simple, south of our borders, to determine which snakes are venomous and which harmless, although the pit vipers can still be recognized by their pits, and most of the coral snakes by the color arrangements of their patterns.

Having given this brief nontechnical survey of venomous snakes in the Americas other than rattlesnakes, we now return to the consideration of this group alone.

LIST OF SPECIES AND SUBSPECIES

In this key the following species and subspecies of rattlesnakes of the genera *Crotalus* and *Sistrurus* are recognized as valid:

1. *Crotalus durissus durissus* Linné, 1758.
   Central American Rattlesnake.
   Southern Mexico to Costa Rica.
2. *Crotalus durissus terrificus* (Laurenti), 1768.
   South American Rattlesnake.
   Costa Rica to Argentina.
3. *Crotalus unicolor* van Lidth de Jeude, 1887.
   Aruba Island Rattlesnake.
   Aruba Island, Dutch West Indies.
4. *Crotalus basiliscus* (Cope), 1864.
   Mexican West-Coast Rattlesnake.
   West Coast of Mexico from Sinaloa to Oaxaca.
5. *Crotalus enyo* (Cope), 1861.
   Lower California Rattlesnake.
   Central and southern Baja California.
6. *Crotalus molossus molossus* Baird and Girard, 1853.
   Northern Black-tailed Rattlesnake.
   West Texas to central Arizona and south to northern Durango.
7. *Crotalus molossus nigrescens* Gloyd, 1936.
   Southern Black-tailed Rattlesnake.
   Central Mexico from Durango to Puebla.
8. *Crotalus adamanteus* Beauvois, 1799.
   Eastern Diamond Rattlesnake.
   Coastal plains of the southeastern states.
9. *Crotalus cinereous* Le Conte in Hallowell, 1852.*
   Western Diamond Rattlesnake.
   Arkansas to southeastern California and south to San Luis Potosí.
10. *Crotalus tortugensis* Van Denburgh and Slevin, 1921.
    Tortuga Island Diamond Rattlesnake.
    Tortuga Island, Gulf of California.

* Previously known as *Crotalus atrox* Baird and Girard, 1853.

11. *Crotalus lucasensis* Van Denburgh, 1920.
San Lucan Diamond Rattlesnake.
Southern Baja California.

12. *Crotalus ruber* Cope, 1892.
Red Diamond Rattlesnake.
Coastal southern California, and northern and central Baja California.

13. *Crotalus exsul* Garman, 1883.
Cedros Island Diamond Rattlesnake.
Cedros Island off Baja California, Pacific side.

14. *Crotalus scutulatus* (Kennicott), 1861.
Mohave Rattlesnake.
Southeastern California to west Texas, and south to the central Mexican plateau.

15. *Crotalus viridis viridis* (Rafinesque), 1818.*
Prairie Rattlesnake.
Western Great Plains from Alberta and Saskatchewan to extreme northern Mexico.

16. *Crotalus viridis nuntius* Klauber, 1935.
Arizona Prairie Rattlesnake.
Northeastern Arizona.

17. *Crotalus viridis abyssus* Klauber, 1930.
Grand Canyon Rattlesnake.
Grand Canyon of Arizona.

18. *Crotalus viridis lutosus* Klauber, 1930.
Great Basin Rattlesnake.
The Great Basin between the Rockies and the Sierra Nevada.

19. *Crotalus viridis concolor* Woodbury, 1929.
Midget Faded Rattlesnake.
Eastern Utah and western Colorado.

20. *Crotalus viridis oreganus* Holbrook, 1840.
Pacific Rattlesnake.
Pacific Coast from British Columbia to central Baja California. Also Arizona.

21. *Crotalus mitchellii mitchellii* (Cope), 1861.
San Lucan Speckled Rattlesnake.
Southern half of Baja California.

22. *Crotalus mitchellii pyrrhus* (Cope), 1866.
Southwestern Speckled Rattlesnake.
Southern California, western Arizona, and northern Baja California.

23. *Crotalus mitchellii stephensi* Klauber, 1930.
Panamint Rattlesnake.
Southern Nevada and east-central California.

---

* Previously known as *Crotalus confluentus confluentus* Say, 1823.

24. *Crotalus tigris* Kennicott, 1859.
Tiger Rattlesnake.
Southern Arizona, and northern and central Sonora.

25. *Crotalus cerastes* Hallowell, 1854.
Horned Rattlesnake; Sidewinder.
Deserts of the southwestern United States and northwestern Mexico.

26. *Crotalus polystictus* (Cope), 1865.
Mexican Lance-headed Rattlesnake.
Tableland of central Mexico.

27. *Crotalus horridus horridus* Linné, 1758.
Timber Rattlesnake.
Eastern United States, Maine to Oklahoma.

28. *Crotalus horridus atricaudatus* Latreille, 1802.
Canebrake Rattlesnake.
Coastal plain of South Atlantic and Gulf states; lower Mississippi Valley.

29. *Crotalus lepidus lepidus* (Kennicott), 1861.
Eastern Rock Rattlesnake.
From west Texas south to northern San Luis Potosí.

30. *Crotalus lepidus klauberi* Gloyd, 1936.
Green Rock Rattlesnake.
Mountains of southern Arizona, southern New Mexico, and extreme west Texas south to Jalisco.

31. *Crotalus triseriatus triseriatus* Wagler, 1830.
Mexican Spotted Rattlesnake.
Central Mexican plateau.

32. *Crotalus triseriatus pricei* Van Denburgh, 1895.
Arizona Spotted Rattlesnake.
Southeastern Arizona to Durango.

33. *Crotalus stejnegeri* Dunn, 1919.
Long-tailed Rattlesnake.
Mountains of eastern Sinaloa and western Durango.

34. *Crotalus willardi* Meek, 1905.
Ridge-nosed Rattlesnake.
Southern Arizona to Zacatecas.

35. *Sistrurus ravus* (Cope), 1865.
Mexican Ground Rattlesnake.
Central Mexican plateau.

36. *Sistrurus miliarius miliarius* (Linné), 1766.
Carolina Ground Rattlesnake.
From North Carolina to central Alabama.

37. *Sistrurus miliarius barbouri* Gloyd, 1935.
Southeastern Ground Rattlesnake.
The Gulf lowlands from Georgia to Mississippi; Florida.

38. *Sistrurus miliarius streckeri* Gloyd, 1935.
    Western Ground Rattlesnake.
    Southern Missouri to Louisiana and west to central Texas.
39. *Sistrurus catenatus catenatus* (Rafinesque), 1818.
    Eastern Massasauga.
    Central New York west to eastern Oklahoma.
40. *Sistrurus catenatus tergeminus* (Say), 1823.
    Western Massasauga.
    Southwestern plains from central Kansas to northern Tamaulipas and southeastern Arizona.

While the ranges of the several forms are broadly indicated in the above table, more specific and detailed range limits will be found under each species or subspecies in the key itself. For page references to key characters and descriptions, and cross references to the appropriate maps and photographs of each species see the index.

VALIDITY

Decisions as to the validity of the several species and subspecies of rattlesnakes recognized are based on studies carried on by the writer during the past eight years. Scale counts and other data have been available on about 8000 specimens. All except four of the forms have been seen alive.

NOMENCLATURE

Although during the past two years I have given considerable time to a study of rattlesnake nomenclature, in the preparation of this key it was first decided to make no fundamental departures from current practice in the technical names employed, even though the validity of several might be questioned. It was feared that shifting some of the names long established in the literature might be a handicap to the adoption of the key, which I hoped would prove of practical value. Therefore the key first went to press with only minor changes in current usages.

But meanwhile I have had a further opportunity to discuss this phase of the situation with some of my herpetological friends. They have pointed out that as the key is presumed to clarify certain species differences, and as a long time must elapse before a second edition can be issued, such changes as are certain to be required eventually should be made at this time. To make the changes later, in a subsequent paper, would render the key obsolete only a short time after its issuance, and add to the confusion. This seems to be a logical view.

I know that to some these changes will appear a useless and over-technical imposition. But this is not hair-splitting nor the evidence of a contentious desire to disturb the peace. The changes will inevitably be made some day as studies of the species and literature continue, and "it is wiser for the present generation to bear with the temporary inconvenience of a few changes than to transmit to future generations our nomenclatorial problems, augmented a hundred fold by the addition of the ever-increasing number of systematic units made possible by the like increase in the amount of literature."*

The important changes from current usage which I find necessary are as follows: (1) substitute *Crotalus cinereous* Le Conte in Hallowell, 1852 for *Crotalus atrox* Baird and Girard, 1853; (2) substitute *Crotalus viridis* (Rafinesque), 1818 for *Crotalus confluentus* Say, 1823, affecting all the *confluentus* subspecies; (3) employ *Crotalus durissus* Linné, 1758 as the species name of the neotropical rattlesnake, relegating *terrificus* (Laurenti), 1768 to subspecific status as the name of the South American form; and finally (4) use *tergeminus* (Say), 1823 as the subspecific name of the western massasauga rather than *edwardsii* Baird and Girard, 1853.

The reasons which have dictated these decisions are summarized hereunder. I deem it undesirable at this time to give more than a brief outline of the factors involved, reserving for future publication a more complete exposition of these and other questions affecting rattlesnake nomenclature. It is not impossible that other changes will be found necessary as the work proceeds; and in any case it will be advisable to place on record the bases of decision where some currently used, but disputed names, have been retained.

(1) *Cinereous* antedates *atrox.* Although the description (Proc. Acad. Nat. Sci. Phila., Vol. 6, No. 5, pp. 177-182, 1852) is included under Hallowell's description of *Crotalus lecontei* (an invalid synonym of *Crotalus viridis*), nonetheless the description of *Crotalus cinereous,* as LeConte sent it to Hallowell, is printed in full in this publication. The snake which LeConte describes is not the same as Hallowell's *lecontei,* which the latter thought to be the case; on the contrary it is an excellent description of the western diamond rattlesnake and it was collected in an area (along the lower Colorado River†) where no other species could be confused with it. Opinion No. 4 of the Commission seems to be exactly in point: "Manuscript names acquire standing in nomenclature when printed in connection with the provisions of Art. 25, and the question as to their validity is not influenced by the fact whether such names are accepted or rejected by the author responsible for their publication."

(2) Rafinesque's description of his *Crotalinus viridis* (Am. Mon. Mag. and Crit. Rev., Vol. 4, No. 1, p. 41, Nov. 1818) leaves no question as to his meaning. The description, though brief, is clearly recognizable, especially when reinforced by the type locality. The upper Missouri

* International Commission on Zoological Nomenclature, Opinion No. 12, Smithsonian Special Publication No. 1938, p. 20, 1910.

† The description concludes with the words "Colorado, March, 1851" from which one might suppose that this specimen was taken in what is now the state of Colorado. But we know from LeConte's paper on Coleoptera in Ann. Lyc. Nat. Hist. N. Y., Vol. 5, pp. 125-216 at p. 125, that he was collecting along the Colorado River in Dec. 1850 and Mar. 1851, and in the valley of the Gila in Jan. and Feb. 1851. In assigning type localities to his insects he uses such terms as "Deserta fluminis Colorado; ad flumina Colorado et Gila, Martio; ad flumen Colorado circa millia XXX a mare;" or simply "Colorado." Thus it is clear that the type locality of *cinereous* is the Colorado Desert in the Yuma area. From the high dorsal and ventral scale counts we may even venture the guess that the specimen came from the California side of the river.

Valley is the center of population of the prairie rattlesnake; is was extremely plentiful in those days and, in fact, still is in many areas. No other rattler is found on the upper river. Two other rattlesnakes occur on the lower Missouri, the timber rattler and the massasauga, but we know that Rafinesque, in describing *viridis,* had neither of these in mind, for he described them as *C. cyanurus* and *C. catenatus,* respectively, in the same paper in which he described *viridis.*

(3) I have no desire at this time to revive the *horridus–durissus–terrificus–adamanteus* nomenclatorial discussion, always a fruitful source of argument. It is evident, however, that *durissus* Linné, 1758 must either take precedence over *terrificus* Laurenti, 1768 or it must fall entirely as unrecognizable; it is not a *nomen nudum* since a description is given and there was a type specimen, although it has been lost. Therefore it is either a species name or it should not be used at all; it cannot be revived with a date subsequent to 1758 to become a subspecies of *terrificus,* as has been done by some authors. For the present I retain *durissus* as the species name of the neotropical rattler, for while the caudal scale count (24) of the type seems low for this form, the black rhombs with light centers are characteristic of it over large areas in Mexico. This leaves *terrificus* as the South American subspecies.

(4) I prefer *tergeminus* to *edwardsii* as the name for the western massasauga, since I think it describes this rather than the eastern subspecies. I have discussed this with Mr. H. K. Gloyd, who has in preparation an extensive work on *Sistrurus* and we are in agreement on this point, which he will cover fully in one of his papers.

CONDENSED ALPHABETICAL SYNONYMY

In a work of this character it is impossible to include a synonymy under each species. The following condensed alphabetical list of synonyms is given in order that users of the key may ascertain the disposition which the present writer has made of the specific names hitherto proposed which he does not recognize as valid. The reasons dictating the decisions will be offered more fully in a subsequent publication.

In the case of each specific name only the intention of the original describer is considered; the shifts and reallocations made by subsequent authors, often giving the name a scope foreign to the purpose of the original describer, are omitted from presentation. Several species are listed which are not rattlesnakes but, being described under the genus *Crotalus,* are sometimes listed in synonymies of this genus.

Americana Catesby, 1743. Syn. *atricaudatus.* Pre-Linnean name without validity.

Atrox Baird and Girard, 1853. Syn. *cinereous.*

Boiquira Lacépède, 1789. Syn. *durissus.*

Cascavella Wagler in Spix, 1824. Syn. *terrificus.*

Catesbaei Fitzinger, 1826. Nomen nudum. Syn. *atricaudatus.* (Ex Hemprich, 1820?)

Cerberus Coues, 1875. Syn. *oreganus.* May later be recognized as a subspecies covering the southern half of the range of this form.
Collirhombeatus Amaral, 1926. Syn. *terrificus.*
Collilineatus Amaral, 1926. Syn. *terrificus.*
Concolor Jan, 1859. Nomen nudum. Not to be confused with *concolor* Woodbury, 1929, which is valid.
Confluentus Say, 1823. Syn. *viridis.*
Consors Baird and Girard, 1853. Syn. *tergeminus.*
Cumanensis Humboldt, 1833. Syn. *terrificus.*
Cyanurus Rafinesque, 1818. Syn. *horridus.*
Decolor Klauber, 1930. Syn. *concolor* Woodbury.
Dryinas Linné, 1758. Probably syn. *durissus.*
Edwardsii Baird and Girard, 1853. Syn. *tergeminus.*
Elegans Schmidt, 1922. Syn. *ruber.*
Exalbidus Boddaert, 1783. Syn. *durissus.*
Fasciatus Higgins, 1873. Composite syn. *horridus* and others.
Goldmani Schmidt, 1922. Syn. *pyrrhus.*
Gronovii Laurenti, 1768. Description too brief for recognition.
Hallowelli Cooper in Cronise, 1868. Nomen nudum.
Helleri Meek, 1905. Syn. *oreganus.* :
Immaculatus Latreille, 1802. Probably syn. *durissus.*
Intermedius Troschel in Müller, 1865. Syn. *triseriatus.*
Intermedius Fischer, 1882. Syn. *triseriatus* besides being preoccupied by *intermedius* Troschel above.
Jimenezii Dugès, 1877. Syn. *polystictus.*
Kellyi Amaral, 1929. Syn. *scutulatus.*
Kirtlandi Holbrook, 1842. Syn. *catenatus.*
Lecontei Hallowell, 1852. Syn. *viridis.*
Loeflingii Humboldt, 1833. Syn. *terrificus.*
Lucifer Baird and Girard, 1852. Syn. *oreganus.*
Lugubris Jan, 1859. Composite syn. *triseriatus* and *polystictus.*
Melanurus Jan, 1859. Nomen nudum. Syn. *atricaudatus* by locality.
Messasaugus Kirtland, 1838. Syn. *catenatus.*
Mexicana Jan, 1863. Nomen nudum.
Minor Catesby, 1743. Syn. *miliarius.* Pre-Linnean name without validity.
Multimaculata Jan, 1863. Nomen nudum. Syn *polystictus* by figure published in 1874 but this was subsequent to description of *polystictus* Cope.
Mutus Linné, 1766. Not a rattlesnake.
Omiltemanus Günther, 1895. Syn. *triseriatus;* may have subspecific validity for extreme southern area where ventral scale counts are high.
Orientalis Laurenti, 1768. Description too brief for recognition; probably not a rattlesnake.
Ornatus Hallowell, 1854. Syn. *molossus.*
Pallidus Günther, 1895. Syn. *triseriatus.*

Table 1. Summary of Rattlesnake Characters

Species or Subspecies	Number of Specimens	Size*	Dorsal Scale Rows⊙	Ventral Scales: Males	Ventral Scales: Females	Subcaudal Scales: Males	Subcaudal Scales: Females	Supralabials	Infralabials	Scales Anterior to Supraoculars	Minimum Scales Between Supraoculars	Body Blotches	Tail Rings: Males	Tail Rings: Females
C. durissus durissus	101	L	(25) 27—*29*—31	170—175—184†	171—181—190†	25—30—33	20—23—28	12—15—19	13—16—20	4— 6—11	2—2.4—5	20—25—32	7—8.6-10	5—6.3—8
C. durissus terrificus	42	L	(25) 27—*29* (31)	166—170—178	171—176—180	22—28—31	20—22—24	11—14—17	14—15—18	4— 5— 9	1—2.3—4	19—24—28	4—6.1—8	3—4.5—6
C. unicolor	3	M	*27*	160—162—163	166	28	22	13	13	4	2	—	—	—
C. basiliscus	94	L	25—*27*—29	182‡-190—200	189‡-196—203	24—30—37	18—24—29	11—15—18	13—16—20	2— 5—10	2—2.8—5	26—33—41	5—8.7-11	4—6.7—9
C. enyo	61	M	23—*25*—27	159—164—168	161—169—177	22—25—28	18—19—23	12—13—15	11—14—16	11—18—30	2—4.2—6	28—33—42	3—6.0—8	4—4.6—7
C. molossus molossus	154	L	25—*27*—29	178—188—198	182—193—201	22—25—29	18—21—25	14—17—20	15—18—21	4— 7—16	2—2.7—7	20—32—40	*	*
C. molossus nigrescens	130	L	(23) *25*—27	167—174—185	172—178—186	21—24—27	16—20—24	13—16—19	14—17—19	4— 6—10	2—2.1—5	17—28—34	*	*
C. adamanteus	45	L	27—*29* (31)	165—171—175	174—178—182	27—30—32	22—24—26	12—14—16	15—18—21	10—21—33	4—6.2—8	26—30—34	5—6.9-10	3—4.3—6
C. cinereous	682	L	(23) *25*—27 (29)	170—182—193	173—185—196	19—26—31	16—20—26	12—15—18	14—17—20	10—19—32	3—4.5—8	25—35—45	3—5.3—8	2—4.1—6
C. tortugensis	28	L	25—*27*	180—184—190	183—186—189	22—24—25	16—18—19	14—16—18	14—17—18	9—14—19	4—4.4—6	32—37—40	4—5.3—7	3—3.4—4
C. lucasensis	348	L	(25) *27*—29 (31)	179—189—199	183—193—203	22—25—29	17—20—25	12—16—19	13—18—21	13—24—41	3—5.9—9	20—30—38	3—4.7—6	2—3.9—5
C. ruber	291	L	(25) 27—*29*—31	185—193—203	188—197—206	21—26—29	16—21—26	13—16—19	14—18—21	11—24—40	4—6.4—9	29—36—41	3—5.0—7	2—3.9—5
C. exsul	22	M	*27*—29 (31)	188—191—195	192—194—196	18—22—26	17—19—23	14—17—19	15—17—19	17—24—40	6—7.7—9	30—32—35	3—4 1—5	3—3.7—4
C. scutulatus	393	L	(21) 23-*25*-27 (29)	166—178—190	167—181—192	21—25—29	15—19—25	12—15—18	12—16—18	6—11—21	1—2.1—5	27—36—44	3—5.0—8	2—3.7—6
C. viridis viridis	1886	L	(23) 25—*27*—29	164—178—189	170—185—196	21—26—31	14—20—26	10—15—18	11—16—19	8—22—45	1—3.3—7	33—43—55	6—9.8-15	4—7.4-11
C. viridis nuntius	190	M	(21) 23—*25* (27)	163—171—181	169—177—182	21—25—28	14—19—22	12—15—17	12—15—19	12—21—42	2—3.6—8	33—42—53	5—9.5-12	5—7.1-10
C. viridis abyssus	32	M	(23) *25*—27	173—178—185	179—184—191	21—25—29	18—20—23	13—16—18	14—16—18	23—34—48	4—6.6—8	38—42—48	7—8 2-12	6—6.9—8
C. viridis lutosus	394	L	23—*25*—27 (29)	171—179—189	174—184—196	18—23—29	13—19—25	12—15—19	13—16—19	11—31—50	3—6.5-10	32—40—49	5—7.1-10	4—5.8—8
C. viridis concolor	23	M	23—*25* (27)	166—173—180	173—179—182	21—24—27	16—18—21	11—14—16	13—15—16	17—34—45	4—5.9—9	37—42—47	7—8.5-11	6—7.1-10
C. viridis oreganus	1394	L	23—*25*—27 (29)	158—174—190	165—178—194	18—24—29	15—19—26	11—15—18	13—16—20	7—25—50	2—5.0—9	23—34—46	3—5.1-10	2—3.9—8
C. mitchellii mitchellii	93	M	(23) *25*—27	171—177—183	172—179—186	22—25—28	16—20—23	13—16—19	13—16—17	20—35—46	3—5.5—8	26—32—39	3—3.8—5	3—3.2—4
C. mitchellii pyrrhus	215	L	(21) 23—*25*—27	168—178—185	168—179—185	20—24—28	16—19—23	13—16—19	14—16—19	21—35—52	4—5.9—8	23—33—42	4—5.6—9	3—4.5—6
C. mitchellii stephensi	70	M	(21) *23*—25	166—174—181	173—179—182	23—25—28	17—19—22	12—14—16	13—15—18	13—25—38	3—5.5—8	30—37—43	5—6.6—9	3—4.5—6
C. tigris	47	M	21—*23*—25 (27)	158—165—172	164—169—174	23—25—27	16—19—21	11—14—15	11—14—16	11—17—37	3—4.8—8	37—43—52	6—8.0-10	4—6.0—7
C. cerastes	316	M	(19) *21*—23—25	132—142—151	135—145—153	17—21—26	14—17—20	10—12—15	10—13—16	12—19—34	2—4.3—6	30—36—47	3—4.7—7	2—3.8—7
C. polystictus	18	M	25—*27*	162—168—177	169—177—186	25—27—29	17—20—23	13—14—15	11—14—16	6— 8—10	1—2.9—5	35—42—47	5—6.1—7	4—5.1—7
C. horridus horridus	123	L	21—23—25	160—168—173	164—172—178	20—24—29	16—20—24	10—13—16	11—14—17	4—17—35	3—6.4-10	15—23—28	*	*
C. horridus atricaudatus	58	L	(21) 23—*25*	164—171—179	168—175—181	24—27—30	20—22—25	12—14—16	13—15—18	6—17—38	5—6.6—9	23—26—29	*	*
C. lepidus lepidus	22	S	21—*23*	148—160—166	154—161—167	22—25—27	19—19—21	11—12—13	10—11—12	6— 9—16	1—2.9—4	15—18—24	3—4.0—5	3—3.2—4
C. lepidus klauberi	133	S	(21) *23* (25)	152—161—171	155—163—172	21—25—28	17—20—24	10—12—14	9—11—13	5— 8—13	1—2.7—4	13—17—21	1—2.8—7	1—2.2—4
C. triseriatus triseriatus	69	S	21—23—25	138—150—161§	141—152—161§	25—28—32	17—21—26	9—12—14	9—11—13	4— 8—12	1—2.7—4	22—38—57	4—6.1-11	2—4.7—9
C. triseriatus pricei	107	S	*21*—23	150—157—167	152—162—171	19—25—29	18—21—23	8— 9—12	8—10—13	5— 7—11	1—2.3—3	37—51—60	4—7.4-10	2—6.2—9
C. stejnegeri	3	S	25—27	174—177—181	—	43—44—46	—	14—15—15	14—16—17	10—16—21	6—7.0—8	40—42—43	11—12 -12	—
C. willardi	32	S	*25*—27 (29)	145—151—158	147—155—160	25—28—32	21—24—29	12—14—17	12—14—15	19—34—55	3—7.3—9	20—23—29	1—3.0—4	2—3.0—4
S. ravus	16	S	*21*—23	138—145—150	142—146—149	26—28—30	20—23—25	10—11—12	9—11—12	4	1	25—28—31	4—5.2—6	3—3.5—4
S. miliarius miliarius	76	S	21—*23* (25)	122—131—136	130—135—140	28—33—37	25—29—32	9—11—12	10—11—13	4	1	25—32—41	6—9.5-13	5—8.0-12
S. miliarius barbouri	28	S	21—*23*	128—135—143	134—142—146	31—34—37	27—30—33	9—10—12	10—11—12	4	1	30—37—44	9-10.6-14	10-11 2-13
S. miliarius streckeri	99	S	(19) *21*—23	123—128—135	123—130—135	30—34—38	26—31—34	9—10—12	9—11—13	4	1	22—30—40	8-10.2-13	7—9.3-12
S. catenatus catenatus	77	M	(21) 23—*25*—27	130—138—145	138—143—147	23—28—32	19—23—27	10—12—14	10—12—16	4	1	24—31—39	5—6.4—8	4—5.4—7
S. catenatus tergeminus	33	M	23—*25*	138—149—155	113—152—160	28—30—33	21—25—27	10—12—14	11—13—11	4	1	31—38—45	7—8 1-10	3—6 2—8
TOTAL	7948													

* The size category is roughly as follows. L (large) signifies a species of which the adult males often exceed 1000 mm (39 in.), M (medium) covers the range 650-1000 mm (25-39 in.), and S (small) that below 650 mm (25 in.). These figures refer to large rather than the extraordinary specimens which may be encountered occasionally, also the optimum habitat for the species is presupposed.

⊙ The figure in italics is the mode, those in roman are of frequent occurrence, while those in parenthesis are rare. In all other columns the first figure is the minimum, the central figure the average, and the last is the maximum. Freak specimens are not recorded.

* The tails are too dark to permit counting the rings accurately

† Not including Panaco Island specimens which are higher

‡ Not including Oaxaca specimens which are lower

§ Not including Guerrero specimens ([illegible]) which are higher

Palmeri Garman, 1887. Syn. *lepidus.*
Piscivorus Lacépède, 1789. Not a rattlesnake *(A. piscivorus).*
Pulverulentus Cope, 1883. Syn *viridis.*
Pulvis Ditmars, 1905. Probably based on an albino *C.d. durissus,* but might be *C. unicolor.* More material is required for a decision.
Rhombifer Latreille, 1802. Syn. *adamanteus.*
Salvini Günther, 1895. Syn. *scutulatus.* May be a valid southern subspecies.
Simus Latreille, 1802. Syn. *durissus.*
Sonoraensis Kennicott, 1861. Syn. *cinereous.*
Strepitans Daudin, 1803. Description inadequate; probably syn. *durissus.*
Tesselatus Hermann, 1804. Cannot be recognized; resembles *triseriatus* in scale counts, and *durissus* or *adamanteus* in size and pattern.

SUMMARY OF CHARACTERS

To permit an additional check on the determinations which may be made by the use of this key, Table 1 is presented, giving some of the more important scale counts of the various species and subspecies. If it be found that the specimen under consideration differs extensively in some of these characters from the numerical range given in the table the result of the determination may be viewed with suspicion and a recheck should be made.

The setting forth of scale-count data in abbreviated form presents certain difficulties. The usual method of giving minimum, maximum, and average shows nothing as to dispersion, that is, how closely most of the specimens cluster about the mean; and if either the maximum or minimum represents a freak or defective individual (as is not infrequently the case) or an error in counting or sexing, the mental picture of the dispersion is distorted, overemphasis being placed on a single specimen out of the many which may have been examined. This is particularly true where broods of young have been included, since they often seem to contain freaks (especially if bred in captivity) which probably would not survive in nature. As an example of such a freak we have a defective juvenile female *lucasensis* with 170 ventrals; the lowest normal individual has 183. Again as a sample adult freak we note an *oreganus* with 33 scale rows, while no other specimen out of 1343 has more than 29 and only 6 have that many.

Even the average leaves much to be desired when we deal with a form which is territorially variable, since the resulting figure is dependent on the origin of the individuals comprising the group averaged. Thus male *cinereous* average 185.0 ventrals in California and 177.7 in southern Texas; obviously the relative numbers from each area which may be contained in the composite *cinereous* group will affect the average.

Only a graphic presentation, or a tabulation of the variation of each item in percentages, will give a true picture of the dispersion, but in a condensed table this is impossible. So also is the presentation of the interquartile range and the probable error of the mean, which are of interest in a complete statistical statement.

For these reasons, while I have set forth in Table 1 the minimum, average, and maximum of each item, the minima and maxima are not always the extremes recorded; rather they are what might be termed the normal extremes, eliminating the solitary individuals here and there which seem to be freaks.

The numbers of scale counts available are also given as an indication of the validity of the figures. Obviously, where only a few specimens have been at hand, neither numerical ranges nor averages can be considered of much value.

USE OF KEY

The key is prepared in the usual dichotomous form, in which the selection is consecutively limited to one of successive pairs of alternatives. In the present instance, to facilitate reference, the alternatives are designated by the letters "a" and "b." Where one of the two leads directly to a species (and thus to a conclusion), the arrangement is such that the "b" alternative is selected to take this course.

No identification key can be made infallible when the forms are closely related or intergrade; and, in the case of the rattlesnakes, because of the great variability in their lepidosis and patterns, it has been particularly difficult to select key characters which lead invariably to the correct conclusion. This is not an argument against the validity of the species and subspecies which have been recognized; many characters which are important in taxonomic studies are unsuitable for use in keys because they presuppose the availability of other specimens for comparative purposes. Other characters require special preparation and are therefore seldom at hand, as, for instance, venom and extruded hemipenes. Even the scale counts, which are of primary importance in classification when handled statistically, are often of little use as key characters because of overlapping. Thus, while it can be shown that the difference between the number of ventral scales in *scutulatus* and *cinereous* is highly significant mathematically, there is a sufficient overlap so that the character becomes virtually useless in a key. Besides, a key must usually shunt out a single species from a group (those remaining undetermined at each point) and there is seldom a case in which some member of the group fails to overlap considerably, in these statistical characters, the single species it is desired to key out.

In accuracy of determination the present key leaves much to be desired. This is because of the frequency of aberrant specimens which deviate from the mode. For example, in *pyrrhus* we have occasional specimens which have prenasals in contact with the rostral; and some specimens of *ruber* have undivided first infralabials, while conversely, some *cinereous* specimens have these scales divided. The internasal criterion (see 23b) in selecting *viridis* and its subspecies, although the best character available, fails in an appreciable number of cases, as shown in the following table:

	SPECIMENS TESTED	FAILURES	PER CENT FAILURES
Viridis viridis	1837	37	2.0
Viridis nuntius	185	8	4.1
Viridis abyssus	30	1	3.2
Viridis lutosus	335	21	5.9
Viridis concolor	19	2	9.5
Viridis oreganus	1142	170	12.9
Total	3548	239	6.3

Oreganus, it will be noted, is conspicuously the worst offender.

Where possible, more than one key character has been set forth so that the selected path may be verified. As a result the key is no doubt subject to criticism on the score of prolixity; yet I know of no other way to secure even approximate accuracy with a group such as the rattlers, in which a single universally consistent key character is so seldom available for any species. Condensed keys often lead to unsatisfactory determinations in large genera, especially where a single specimen (rather than a large series from one area) is to be identified, as anyone will testify who has tried to use the existing keys for such genera as *Pituophis, Thamnophis, Sceloporus,* and *Uta.* In such keys long experience in the genus must be had before the key can be applied with accuracy.

In order to minimize further the effect of the key failures, a brief color description is incorporated with each alternative which leads finally to a species or subspecies; but the antithetical description is not given unless the pattern, or color, constitutes a part of the key. Occasionally footnotes direct attention to special deviations or to certain precautions which will reduce inaccurate findings.

Where color and pattern are a part of the key one should not only allow for the ordinary fluctuations within a species but must be on the lookout for melanistic or albinistic individuals (fig. 111). Partial albinos, with one or more color-principles lacking, are also met with; these are particularly confusing unless normal specimens from the same area are available for comparison. Preserved specimens, which are faded or from which the epidermis has been rubbed away through continued handling or drying, thus changing both color and pattern, must be guarded against in making comparisons. Preservation tends to dull the brighter colors into neutral grays and browns; this is especially true of red and yellow. Specimens which have been long in captivity sometimes rub their snouts on the barriers so continuously as to deform the rostral and internasals in shape and arrangement; such changes should be noted where the key uses these scales.

Under each species the range has been set forth, as far as known, and there should be no hesitancy in using this as a check on the determination, when the locality of collection of the specimen is available. Of course if the specimen keys to a species known to occur only a short distance from the place of collection, the identification may be presumed to be accurate, for range extensions are to be expected in the future as larger and more thorough collections become available. On the other hand, if, for example, a Pacific Coast specimen is found to be *horridus* or *adamanteus,* the error must be in the key or its use, since neither of these species occurs within a thousand miles of that territory. The key is a working tool; imperfections are to be expected and therefore all information available on the specimen, including the locality, should be used to verify the determination.

RATTLESNAKE RANGES

The ranges are described as closely as the available specimens and records permit. To facilitate these descriptions tabulations and large-scale maps were prepared for each species or subspecies; altogether several thousand locality records were available, although comparatively few were at hand in the case of some of the rarer forms. In some areas—this is particularly true of Mexico—the authoritative records are rather scanty and the results have been somewhat generalized. Usually territories listed as within the range of a species are limited to those from which specimens or authentic records have been available; but in some instances where it is evident that a species occurs in intervening territory between two records, its presence there has been assumed.

Due allowance has been made for the character of certain early records. In the days of the Indian wars in the West, material was often gathered from a considerable area, yet was labeled by the recipient museum with the locality of the fort or army post from which it was sent. As a further complication these posts were sometimes moved for considerable distances without change of name. Therefore these old records have been neglected if they appear questionable, as indicated by currently available specimens and the present knowledge of habitat preferences.

Published locality records of species whose definitions have been confused in the literature have been discarded unless verified by specimens. Examples: *triseriatus* confused with *polystictus; cinereous* with *scutulatus; durissus* with *basiliscus* or *molossus,* and the latter with each other.

It should be understood that when an area is specified as the range of a species this does not mean that it is to be found universally distributed throughout that area. In some sections the encroachments of civilization, such as industrial and agricultural developments, irrigation, the cutting of forests, or drainage of marshes, have caused the disappearance of species from whole districts which they once inhabited. And even where natural conditions remain, a species is often not spread evenly throughout a territory. This is particularly true in the southwest, where ecological conditions vary greatly within short distances owing to changes in altitude or topography. Thus while three rattlesnakes may be said to occupy the same geographical area (a county, for example), one may occur only on the plains, another amongst rocky foothills, and the third upon the higher peaks. None is found uniformly distributed over the entire area, yet the county would be included in the designated range of all three. Space limitations have made necessary the same type of generalization in the range maps which accompany this key.

SUMMARY OF RATTLESNAKE LIFE HISTORY

While it is impossible, within the scope of this key, to present a complete account of the life history of the rattlesnakes, it is desirable not to leave this feature untouched. The following paragraphs outline some of the more important or interesting facts concerning rattlesnakes and their ways. The necessity for abridgment has required rather broad generalization on some phases, and therefore this brief discussion should not be judged too severely by those already familiar with the subject.

Habitats.—While most species of rattlers thrive in arid or semi-arid areas, particularly in rocky or brushy country, there are others which are not averse to swamps or timbered lands. Some forms, such as *C. triseriatus,* seek mountain areas; *C.m. stephensi* prefers rock-strewn canyons; *C. cerastes* is at home in sandy desert wastes. In California, rattlers *(C.v. oreganus)* are found at an altitude of 11,000 ft., and in parts of Mexico *C.t. triseriatus* occurs up to 14,500 ft. They have been found on the sands of the seashore only a few feet from the waves and occasionally have been seen swimming in the sea as well as in lakes. While no rattlesnake is as aquatic as the water or garter snakes, they will take to water at times, and the little known *C. polystictus* may be semiaquatic. Rattlers being heavy bodied, are less arboreal than many other species of snakes; however they occasionally climb trees, no doubt in search of squirrels or birds. They are sometimes found crawling through chaparral well above the ground. Clumps of cacti are favorite refuges of some of the western forms, which are not impeded by the spines.

An adherence to a certain ecological niche cannot always be specified for a given rattlesnake. It is not only that some forms are more tolerant than others, which is the case, but that a species may be restricted in ecological range in one area and not in another, owing possibly to competition or other more obscure conditions. Thus *scutulatus* is a snake of the flatlands in the Mohave Desert; in Arizona it is not only a desert, but a foothill and even a mountain form. In Arizona *cinereous* is an Upper as well as Lower Sonoran form, but in southern California it is exclusively a desert inhabitant; here it has never secured a foothold even on the lower mountain slopes, probably owing to the competition of the closely related *ruber.* Hence in these brief notes it has often been impossible to cite the habitat preferences of a form because of this variability within a species.

It is probable that in pre-Columbian times at least one species of rattlesnake was found in every part of what is now the United States excepting eastern Maine, upper Michigan, northern Wisconsin, central and northern Minnesota, eastern North Dakota, and Washington and northern Oregon west of the Cascade Mountains. The higher mountains were likewise untenanted, the altitude not invaded depending on local conditions. While in southern California rattlers have been observed at an altitude of 11,000 feet, further north and in the Rockies the more rigorous climate holds them to lower levels.

Where a species is approaching its toleration limit (in habitat conditions) its range may be highly irregular and intermittent. Thus only the lowlands in mountainous territory may be inhabited (as is the case, for example, in central Idaho and western Montana) and the range may be as irregular and broken as are the contours of the river-valleys, with further modification resulting from the nature of the exposure, for snakes range higher on slopes with a southern exposure.

As far as numbers of forms are concerned Arizona is the headquarters of the rattlesnakes, no less than 15 subspecies being found within the limits of that state. However, because of their restriction to certain ecological niches, as previously mentioned, it is doubtful whether more than 5 or 6 species actually meet in any one locality.

While rattlers have been exterminated in many industrial and agricultural areas, it is probable that in a few places they are now even more numerous than in primitive times. This may be the case where agricultural development, or the destruction of competitive predators, have served to increase the supply of rats, mice, gophers, ground squirrels, and the other rodents upon which most of the species feed.

Economic Status.—Rattlers are of considerable economic importance in many areas, since they serve as a check on destructive rodents. However, one would hardly recommend their protection, particularly adjacent to cities, because of the danger to humans inherent in their presence. It would be best if they could be replaced by other snakes such as the bull snakes, gopher snakes, and rat snakes, which have an equal economic value (in the destruction of harmful rodents) but, being harmless, do not have the one outstanding objectionable quality of the rattlesnakes, namely, their venomous character. Incidentally it may here be stated that when a person, through mental laziness, refuses to discriminate between harmless and venomous snakes, and kills all snakes at sight, he is defeating the very purpose of his act. Every time he kills a harmless gopher or king snake he is making room in the economic scheme of things for one more rattler, for the number of these snakes is limited by the available food supply.

Habits.—While rattlesnakes are diurnal in spring and autumn, they are largely nocturnal in summer, this being especially true of the species found in the Upper and Lower Sonoran Zones. In the spring when they first issue from hibernation, they are abroad in search of food and mates, and are rather careless of concealment. At this season they are occasionally found in pairs, but the widespread belief that if one rattler be killed its mate will shortly appear at the scene of the tragedy is quite erroneous. Later they become secretive, their activities being restricted largely to the evening hours or night, when the heat is not excessive, and when the rodents which constitute their principal food are abroad. In the daytime they seek refuge in ground holes, in the shade of dense thickets, or under rocks. In the arid Southwest no rattlesnake can stand the direct heat of the summer sun. Under such conditions even the desert sidewinder will succumb within ten or fifteen minutes.

In the colder climates rattlers hibernate together in large numbers, going into hibernation about mid-October and emerging in mid-April, the dates varying somewhat with latitude and altitude. In some areas rocky retreats are preferred; in others, prairie dog towns or other ground holes. In milder climates the snakes do not gather in large groups for hibenation but seek separate refuges. Here they may come out briefly at any time during the winter if there is a warm spell.

Rattlers are secretive and timid. When approached they will usually remain quiet in order to avoid detection, and when discovered will endeavor to escape if given an opportunity. It is only when they are frightened and cornered that they will stand their ground with a strident warning to the intruder. Stories of rattlers chasing a person are probably the outgrowth of instances wherein the man stood between the rattler and his natural refuge, usually the nearest bush or rock cleft. Rattlers will not strike unless they are disturbed or frightened; they are not innately vicious, but seek only to defend themselves or escape. They do not always rattle before striking, as this depends on the disposition of the individual snake and the nature of the disturbance which has alarmed him. They can bite without coiling, but cannot strike without first throwing themselves into the loose S-shaped coil with raised forebody which constitutes the striking posture (fig. 108). The strike is merely a forward lunge of the head and rarely exceeds half the length of the snake; if the snake is violently excited, it might reach three quarters. At the end of the strike the mouth is widely opened and the forward pointing fangs (fig. 1c) are driven into the victim. The strike is made with such rapidity that the forward drive of the head cannot be followed with the eye; one can see only the white blur of the open mouth where the direction of motion is reversed. The head is retracted more slowly. The mouth is not opened until near the end of the strike; rattlers do not threaten their enemies with open mouth as sometimes pictured.

The resting coil (fig. 109) in which rattlers are usually found is quite different from the striking coil. A rattler cannot strike when in the resting coil, but if alarmed rears up and quickly throws himself into his characteristic defensive posture. The striking coil not only facilitates a possible forward lunge but also bodily maneuver, for in this posture the snake can move backward or to either side where a safe retreat may offer; but meanwhile he faces his foe, ready to strike if the enemy comes within range. A big rattler, thoroughly alarmed, is something both to see and hear. Not only is the rattle sounded continuously but the cornered snake inhales and exhales with a violent hiss; the posterior body is flattened;

and the protruding tongue is held alternately pendent, and vertically erect, with the tips widespread.

Rattlers, in the striking coil, rear up to about 6 to 12 inches with the head a trifle lower than the lateral curve of the neck; they strike slightly downward, usually well below 12 inches, so that heavy leather boots or puttees afford good protection for the legs. A large rattler can puncture thin flexible leather. *Crotalus durissus* has a striking posture resulting in a higher strike than that of our nearctic rattlers. Since rattlesnakes are not naturally vicious and do not attack unless disturbed, the principal danger to hiker or hunter results from walking along a trail without watching his step so that a rattler which has not been seen may be trod upon. Under such circumstances a rattler would bite without coiling or a warning rattle. Occasionally accidents happen to persons climbing about amongst rocks and placing their hands in a fissure in which a rattler lies concealed, or in walking abroad at night without a light. Farmers trimming shrubbery sometimes suffer from having disturbed a rattler lurking there. To city folk the best advice is, "Watch where you place your hands and feet; don't put them into places you can't see."

Rattlers, being thick of body, crawl rather slowly. Usually they adopt a sinuous motion (fig. 110) ; sometimes progression is caterpillar-like and they leave an almost straight trail. The sidewinder has a peculiar rolling motion, developed for efficient transit over loose sand. In this, with head anchored, the body is thrown to the side in a loop, after which the head is moved. The resulting track is not continuous, but is a series of short lines advancing *en échelon.*

Food.—Rodents, such as rabbits, ground squirrels, prairie dogs, gophers, rats, and mice, comprise the natural food of most species. Birds are occasionally eaten. Some of the smaller species, such as *lepidus, triseriatus,* and *cerastes,* are largely lizard feeders, although they do not scorn small rodents when obtainable. Rarely other snakes are eaten.

Rattlesnakes always strike and poison their prey; that is what the venom is for—to kill the prey; as a means of defense it is secondary and incidental. The prey is struck but not held by the rattler. The small animals quickly succumb to the venom and are then eaten, usually head first. The stomach juices of the rattler are very powerful and every part of the prey is digested except hair or feathers. It is probable that in their natural state they feed at approximately weekly intervals, if a full meal is obtained.

Rattlers do not feed well in captivity and many die of self-imposed starvation if disease does not supervene. They do not charm their prey but secure it by stealth, lying in wait for it to come within range of the deadly stroke. Most animals placed in a cage with rattlers show no fear of them. A hungry rat with no other food available will sometimes kill a rattler in whose cage it has been placed as food. Zoo visitors are heard to express surprise that two or more rattlers can be placed in the same cage without an immediate fight. As a matter of fact being peaceful, they get along well with each other and with other snakes.

Size.—The largest of rattlesnakes is the Eastern Diamond, *C. adamanteus.* which reaches a length somewhat in excess of 2400 mm. (8 ft.) and a weight of more than 15 pounds. This is the largest, that is the heaviest, of all venomous snakes; the longest is the king cobra. Other very large species are *C. cinereous* and *C. durissus.* The smallest rattler is probably *C. willardi* or *C. stejnegeri,* which scarcely reach 590 mm. (2 ft.); the latter is also the rarest (in collections), only 3 specimens being available to date. For a rough classification of rattlesnakes as to length, see the appropriate column in Table 1.

Adult male rattlesnakes average larger than females by about 8 per cent; they are also somewhat more plentiful. Males can be distinguished from females by their relatively thicker and longer tails; in the females there is a distinct reduction of diameter where the tail begins, while in the males the taper at this point is more gradual. Rattlesnake growth is quite rapid during the first two years of life, after which it is much slower. The young of rattlesnake species having an average ultimate length of 1220 mm. (4 ft.) will be about 265 mm. (10½ in.) at birth. Rattlesnake lengths determined from skins are inaccurate owing to stretching.

Reproduction.—Our nearctic rattlesnakes mate in the spring, soon after leaving hibernation. The young are born between mid-August and early October, depending on the species and the geographical area inhabited. Although many kinds of snakes lay eggs, others, including rattlesnakes, are born alive. Broods vary in size from 2 or 3 to 30 or more, but average about 10. Female rattlesnakes give birth to their first broods when three years of age. Young mothers have smaller broods; also the smaller species have fewer young. Young rattlesnakes shift for themselves immediately after birth; occasionally a mother is found with her young, which probably have been born but a few hours before, or they are using a common retreat. The long-existent theory that parent rattlesnakes swallow their young for protection is not true.

Control.—Various methods of rattlesnake control have been tried, such as the use of snake-proof fences, blasting them out of dens, or poisoning them in such dens with liquids or gases. These means are not often effective; results are much more likely to be achieved by curtailing their food supply, that is, by eliminating the rodents upon which they feed. However, the great concentration of rattlesnakes at hiberating time does offer an opportunity to destroy large numbers within a short period. This is especially true in the colder climates. A. M. Jackley of South Dakota has devised means for capturing rattlers leaving hibernation, and has been successful in securing great numbers of *C.v. viridis.* Whether such destruction is to be recommended on economic grounds is an open question. Bounties have been proposed but cannot be recommended, since they often lead to the importation of snakes from other areas. Hair ropes, of course, are entirely ineffective in keeping rattlesnakes out of a camp; a snake which does not hesitate to crawl over cactus could hardly be expected to notice a hair rope.

Forest and brush fires cause great destruction of rattlesnakes, as they do of all animals occurring in the devastated area. Autos kill many snakes upon the highways.

Rattlesnake Enemies.—Aside from man, the principal enemies of the rattlesnakes are birds and other snakes. Hawks and owls are sometimes observed carrying rattlers or other snakes in their talons. Ravens have been seen to attack young rattlers. A number of kinds of harmless snakes, including especially king snakes and racers, feed frequently or occasionally on other species of snakes, and rattlers are amongst those which fall prey to them. The attitude of the king snake toward rattlesnakes is often misunderstood. King snakes do not range about spoiling for a fight with a rattlesnake; however, when in search of food a young rattlesnake is as tempting a morsel as any other. Some mammals, including a South American skunk, are known to kill snakes. The mortality amongst young rattlesnakes is high, for they are especially vulnerable to birds and snakes. When they have reached maturity they are too much for some of their erstwhile enemies to handle.

Various of the hoofed animals, especially pigs, deer, and goats, are known to kill rattlesnakes, as well as other species. Snakes are said to be scarce where goats habitually graze.

Commercial Value.—Rattlesnake skins are used in the manufacture of such ornaments as belts, slippers, hat bands, purses, and the like. The flesh is edible and in Florida has been canned on a commercial basis. The venom when carefully segregated by species, purified by centrifuging and dried, is used in the treatment of horses in preparation of antivenomous serum; and has certain other medicinal uses upon which research is now being carried forward. Rattlesnake oil is sometimes in demand in certain oriental trade circles.

The snakes themselves are in sporadic demand for snake shows, carnivals, zoological gardens etc. Prices, when there is a market, range from $.50 to $10.00 each, depending on the size and species. The commoner kinds are often sold by weight, bringing from twenty to fifty cents per pound. With the exception of a few experienced and well organized firms which supply much of the American market for these products, few persons are successful in making a livelihood from any phase of the rattlesnake business, since the demand for snakes or snake products is at best sporadic and uncertain.

Finding snakes and catching them are matters of experience. Various kinds of noose-sticks are used for picking them up.* A practiced eye can discover snakes which the novice will overlook, as has often been demonstrated in the field by pointing to a patch of rocks amongst which

---

* For methods of catching and shipping rattlesnakes, see Klauber: Notes on Herpetological Field Collecting. S. D. Soc. Nat. Hist., Collecting Leaflet No. 1, pp. 1-10, 1935.

a snake lies in plain sight. A person who does not know what to look for will have great difficulty in locating the reptile.

The largest catches can be made about dens in the autumn or spring. In desert areas one catches snakes at night by driving on black paved roads, against which background the light-colored snake shows strongly under the glare of the headlights.

Rattlesnake farms, except for their possible exhibition value, are not often successful. In these farms the population is not replenished by breeding, but by acquiring fresh material continuously in the wild, it being impractical to breed snakes in captivity. Caged rattlesnakes are afflicted with diseases and a variety of internal and external parasites which shorten their lives. Rattlers seldom take food naturally in captivity, but often live for a year or more without it. However they must have water.

Rattlers in captivity quickly become lethargic; after a short time they are accustomed to human beings and do not greatly resent handling. Undue familiarity with rattlesnakes, however, is to be decidedly discouraged, as a sudden fright may result in a serious accident. A considerable proportion of snake-bite cases in this country results from handling captive snakes. Pulling the fangs out is an easy, but not a lasting, safety measure, since they will be shortly replaced; and if the operation is carried deeper and the reserve fangs or venom glands are removed, the snake usually dies within a short time.*

Senses.—Zoo vistors, unfamiliar with snakes, frequently are heard to confuse the snake's fangs (which cannot be seen unless the snake yawns) with its tongue. The tongue is a harmless and delicate organ, probably auxiliary to the sense of smell; or it may be partly auditory in function. It is frequently advanced and retracted, especially if the snake is in an unusual situation; with it the snake seems to be sensing his surroundings. An angered or defensive rattlesnake not only protrudes the tongue to the fullest extent but also alternately points it vertically upward and downward. These motions are not hurried, but are made with deliberation. The rattler's tongue is bifurcate and, in nearly all species, is black. When on the alert the tips are spread wide apart.

Rattlers, like other snakes, have ears, but they are without external aural openings. The hearing seems to be dull. The sight also is not of the best, judging by the frequency which captive rattlers are seen to miss their prey, even when it is within easy range. Possibly they see better at night. A short time prior to changing its skin a snake's eye coverings appear bluish and almost opaque. There is an exudation of a liquid between the old and new skins designed to facilitate shedding. At such times the snake is nearly blind. A day or so before exuviation the eye clears up.

The unique pit (fig. 6) which characterizes the snakes of the family *Crotalidae* (the pit vipers) is another sense organ, the purpose of which is uncertain, but is thought to be auditory.

* *Re* effect of captivity on rattlesnakes, see Klauber: A Herpetological Review of the Hopi Snake Dance. Bull. Zool. Soc. S. D., No. 9, p. 32, 1932.

Rattles.—The rattle is used for the purpose of warning away enemies which are large enough to cause possible injury to the snake. It is not employed (as has been sometimes stated) to warn prey; this would be contrary to reason. It is not a mating call as has been suggested; in excursions through snake-infested country during the mating season I have never heard a rattle sounded except by a snake that has been disturbed by my companions or myself.

In vibrating the rattle the tail is shaken at the rate of from 45 to 60 cycles per second, the speed depending both on the individual snake and the temperature. The sound, which is caused by the impingement against each other of the interlocking segments of the rattle string, cannot be distinguished as discrete impacts, for it is much too rapid; it is a hiss not unlike escaping steam. A large rattler can be clearly heard at a distance of a hundred feet or more; to have one of these suddenly let go immediately under one's feet is startling indeed. On the other hand, some species—*S. miliarius* for example—have such small rattles that they can scarcely be heard at a distance of a few feet.

The first rattle, or prebutton, is always lost with the first shedding of the skin, which occurs within a day to a week after birth, leaving the permanent button exposed; subsequently the snake acquires an additional rattle with each shedding. Snakes at an age of one year have from 3 to 6 rattles, the number depending on the species of snake and the duration of its seasonal activity. Thus the age of a rattler can only be approximated from the number of rattles, and then only if the button be present, showing that the string is complete. Rattles are lost through wear, so that strings exceeding 15 segments are extremely rare. I have not seen one with more than 13 segments which still retained the original button. Adult snakes usually have from about 5 to 10 rattles; the loss of the additional segments is not a detriment to the snake since long strings are inefficient vibrators. Rattlers living in places where they are seldom disturbed—for example on Tortuga Island—tend to have long strings. The same is true of species—such as the sidewinder—which inhabit sandy areas, for here the rattles do not often catch in the clefts of rocks or shrubs, nor are they abraded by rough objects. Long sets of rattles can be easily faked, which accounts for most of the phenomenal strings which have been reported.

The rattle consists of a horn-like material which is exuded and solidified on a corrugated matrix of tissue prior to the shedding of an old skin. The method whereby each new rattle is advanced one corrugation ahead of its predecessor and yet remains interlocked with it, is mechanically quite complex. It is effected by a wave action of tissue.

I wish to repeat that rattlers do not invariably sound their rattles before striking. Some are so peaceful—*C. ruber* for example—that they will neither rattle nor strike except under great provocation.

Fangs.—The fangs are two greatly elongated curved teeth at the front of the upper jaw. Normally they are folded back against the roof of the mouth (fig. 1b), whence they may be rotated forward and downward into the striking or biting position (figs. 1d and 1e). Of this fang rotation the snake has voluntary control; the fangs are not automatically tilted as the snake opens his mouth. The movements of the two fangs on the opposite sides of the head are independent of each other. When in the resting position they are covered by a white protective sheath of tissue, which is partially pushed back from the points as the fangs are advanced. The fangs are hollow and have an upper and lower opening, the latter just above the point (fig. 1g). The venom is conducted from the venom gland, which lies back of the eye, through a duct to the upper opening (fig. 1l) and thence through the tubular fang to the orifice above the point, thus constituting a perfect natural hypodermic needle. Rattlesnake fangs are replaced at regular intervals even though they are unbroken. On each side of the head there is a pair of maxillary sockets which the active fangs occupy alternately (figs. 1g and 1h). While replacement is under way the old fang may remain in place while the new fang is being ankylosed in the adjacent socket; thus for a short time the rattler may have two fangs on a side. The reserve fangs, from which replacements are made, lie in an orderly series behind each functional fang. There are approximately eight on each side in successive stages of development from rudiments to almost complete fangs. As the reserve is drawn on for replacements additional buds appear, so there is no decrease in the number in reserve. In each individual fang, development takes place from the point upward. The fang develops as a tube, notwithstanding the central longitudinal suture (fig. 1g) which indicates that a remote ancestral form had fangs with open grooves, as is the case with some groups of venomous snakes today. The fangs of the several species of rattlesnakes differ somewhat in curvature and in length proportionate to the size of the head. The curvature aids in imbedding the fangs as the mouth closes.

Venom.—Rattlesnake venom is a yellow liquid having a specific gravity of about 1.08. It may be dried, without serious modification in toxic properties, by heating to 100° F; when dry it will retain its potency indefinitely. In drying, the venom loses about three-quarters of its weight. Dried venom has a yellow crystalline appearance, although the flakes are not true crystals.

The venom is primarily a means of securing food; venomous snakes practically always secure their prey by striking and poisoning it. In effect the venom not only kills the prey but is said to aid in its digestion. There are considerable differences, both in toxicity and physiological effects, in the venoms of the several rattlesnake species, some being 60 times as powerful, drop for drop, as others. Some are primarily hematoxic; others neurotoxic.

The yield of venom per snake varies greatly amongst the different species of rattlesnakes, even though the snakes may be of similar size. The following are a few adult averages, the figures representing the yield in milligrams of dried venom: *C. cinereous*, 270; *C. v. viridis*, 80; *C. v.*

oreganus, 140; *C. m. mitchellii,* 33; *C. m. pyrrhus,* 215; *C. cerastes,* 32; *C. tigris,* 11. A general, but not universal rule, is that rattlers which give low quantitative yields proportionate to their sizes have the most powerful venoms. So far as now known *C. tigris* has the most powerful and *C. ruber* the weakest venom. *C. durissus* seems to have a combination of high yield with powerful venom and therefore may be considered the most dangerous of the rattlesnakes. The maximum venom recovery from a single snake at a single milking was from a large *C. cinereous;* this produced 3.9 cc. of liquid or 1145 mg. of dried, purified venom. This is the highest record among over 4000 rattlesnakes that I have milked, and I know of no greater quantity reported from any kind of venomous snake.

A satisfactory procedure in "milking" large rattlers is as follows: An assistant catches the snake immediately behind the head by means of a noose-stick, and holds it with the head resting on the edge of the table. When the snake is so caught and held it has no opportunity to reach any object with its fangs and thus waste venom. The operator by means of a metal hook catches the snake's upper jaw under the rostral plate and tips the head back. Then the rim of a porcelain cup is introduced below the fang points, and the fangs are drawn downward and forward into the erected position. Since the head is tipped back and steadied by the hook while the cup approaches, the snake can neither see the cup nor slash at it until it is in position to catch any venom expelled.

As the fangs are drawn forward, the edge of the cup is pressed steadily against them; this tends to hold the head firmly and gives the snake a feeling of something yielding on which to bite. The hook is now withdrawn, and the operator, further forcing the head against the cup with his index finger, presses the venom glands with the thumb and third finger. The snake will usually eject some venom in an attempt to bite when it feels the steady pressure of the cup against the fangs, but in all cases the flow is increased by the mechanical manipulation of the glands.

Holding the snake with a noose-stick is not a suitable method for the smaller rattlesnakes, whether juveniles of the larger species or adults of the smaller, since their heads will not protrude far enough beyond the holding strap to permit manipulation. With these small specimens (say under 800 mm.) an operator can work most efficiently alone. In this process a centrifuge tube or test tube is firmly attached to a stand or vise. The snake is caught by pressing the head against the table with a short straight stick and is then grasped behind the head with the left hand. Using the metal hook to tip the head back, the fangs are hooked over the edge of the stationary tube and the glands are manipulated with the fingers of the right hand. The operator can keep the tail of the snake from thrashing about by placing it between himself and the work table, and then leaning against it.

Many operators recommend the use of a thin rubber or parchment cover for the venom cup or tube, to be bitten through by the snake. This may be justified for short-fanged snakes, but I have not found it efficient with rattlesnakes, since it impedes rapidity of operation, and does not increase the yield. When a diaphragm is used, venom is frequently spilled on it before the fangs penetrate; and as the fang points cannot be seen after they have gone through the diaphragm, it is impossible to observe the effectiveness of the manipulation of the glands, or when the flow has ceased.*

In the wild, snakes are presumed to use only a small quantity of their venom in securing their prey, for no more is needed to cause the death of these small creatures within a minute or so. Rattlers have complete muscular control of the quantity of venom discharged, and naturally will not waste it. In biting an enemy in anger they probably eject from one half to two thirds of the quantity which may be secured by manipulation in the milking process.

It is presumed (but not definitely known) that a snake in the wild would replenish empty venom glands within two weeks or less. In captivity the secretion is much slower; snakes milked at successive intervals of two weeks show a sharply declining supply. For this reason a continual accession of fresh specimens is necessary for an adequate supply of venom.

Young snakes have venom at birth, but because of their small size it is quite limited in quantity; the bite of such an infant would probably be painful but not dangerous. Very old snakes show evidence of a declining venom secretion.

Snake Bite and Treatment.—Although rattlesnakes are moderately plentiful in many areas in the United States which are frequented by large populations, especially on week-end excursions, hunting or fishing trips, or by hikers or campers, rattlesnake bite constitutes a relatively small accident risk; not to be compared, for example, to the chance of a highway accident. The naturally inoffensive and secretive character of the snakes, and the fact that people going abroad are usually well protected about the legs, reduce accidents. Only in a few areas of our country is the snake bite problem sufficiently important to warrant much attention.

The gravity of a rattlesnake bite is something which cannot be closely defined or predicted, any more than one might predict the seriousness of a fall, without knowing the exact circumstances surrounding the accident, such as the height of the fall, the character of the surface struck, etc. And in a snake-bite case the conditions are even more obscure, since there are important factors which cannot be ascertained, even after the accident has occurred. So no one can give an off-hand opinion as to the gravity of such a case; and correspondingly, while there should be no desire to exaggerate the gravity, it will be best, in the interest of safety, to over-treat rather than under-treat the case, provided a proper treatment is used. In any event the victim should remain under close observation for at least 48 hours.

Some of the more important variable factors involved in snake-bite cases are the following:

---

* For the methods used in venom recovery and purification see Klauber: The Collection of Rattlesnake Venom. Bull. Antivenin Inst. of America, Vol. 2, No. 11, 1928.

(1) The size, vigor, and health of the victim, these being important in determining absorptive power and resistance to venom.

(2) The allergy complex of the victim; his susceptibility to protein poisoning; sensitization (anaphylaxis), or partial immunity imposed by previous bites and treatment. Some individuals are so susceptible to venom that the mere handling of it causes typical asthmatic symptoms lasting for 24 hours or more; most persons under similar circumstances are entirely unaffected.

(3) The psychological condition and nature of the victim; extreme fear and apprehension will affect heart action and therefore rapidity of absorption; and it is not impossible that there may be more direct reactions.

(4) The site of the bite, which will be less dangerous in the extremities, or in tissues where absorption will be less rapid (fat, for example), as compared to a bite near the vital organs or penetrating a vein.

(5) The nature of the bite, whether a direct stroke with both fangs fully imbedded, or a glancing blow or scratch. The movement of the victim (jumping backward, for instance) may cause a partially ineffective bite; or a bone may be struck, thus causing imperfect penetration. The snake may misjudge his distance and have the fangs only partially erected at contact, thus resulting in only slight penetration; or he may, for the same reason, eject venom before the fangs are imbedded.

(6) The protection afforded by clothing, which, by interposing thickness, will permit less depth of fang penetration, and will cause the external and harmless absorption of part of the venom. Only the point of the fang may penetrate the skin, in which case there will be no venom injection, for the orifice is well above the tip (fig. 1i).

(7) The number of bites; occasionally an accident involves two or more distinct bites.

(8) The length of time the snake holds on; it may withdraw or be torn loose before injection takes place. This is likely to be more important with the elapine snakes, with their less specialized fangs, than with such long- and hook-fanged snakes as the rattlers.

(9) The extent of the anger or fear upon the part of the snake. The muscles which wring the venom glands and thus inject venom are separately controlled from the biting mechanism. The snake's natural tendency is to withhold venom, since this is his means of securing prey; but if hurt or violently angered he is likely to inject a large part of the venom contained in the glands.

(10) The species and size of the snake, affecting venom toxicity and physiological effects, venom quantity, and (by reason of length and strength of fangs) depth of injection. The age of the snake is likewise important; not only are young snakes less dangerous because of their smaller size (and therefore reduced quantity of venom) but also the venom is less toxic, judging from the reduced proportional recovery of solids upon evaporation. Snakes which have passed their prime also probably secrete less venom and of a reduced quality.

(11) The condition of the venom glands, whether full, or partially depleted or evacuated by reason of recent feeding, defense, ill health, or captivity. The season of the year (proximity to aestivation or hibernation) may also cause a variation, but this is not definitely known.

(12) The condition of the fangs, whether entire or broken, lately renewed or ready for shedding.

(13) The presence, in the mouth of the snake, of various microorganisms, some of which, gaining access to the wound, may, abetted by the anti-bactericidal effect of the venom, entail serious sequelae.

(14) The nature of the instinctive first aid treatment, if any, such as suction, or circulation stoppage by pressure.

To conclude, with variable factors of such importance, it is to be expected that some cases will prove extremely grave, whereas others may cause little or no discomfort. It is the latter class (which really require no treatment) that have given an entirely fictitious value and reputation to some of the remedies which have been proposed, for the patient recovers in spite of the remedy, rather than through its use.

In general, it can be said that even with the crudest treatment, or with no treatment of any kind, rattlesnake bite would probably not be fatal in more than 10 per cent of the cases, although greater with some especially dangerous species. Snake bite is likely to be more serious in the case of children, since the ability of a body to absorb venom without fatal results, varies with the weight. With proper treatment the mortality from rattlesnake bite should be less than 3 or 4 per cent.

In the case of an accident of this kind, be sure that the snake which has inflicted the wound is a venomous snake. Many harmless snakes will bite fiercely when trod upon or captured, but their bites are without any untoward effects; they are no more serious than a scratch and should be given a like antiseptic treatment. Nevertheless, there are authentic instances in which grave results and even death have been caused by fear following the bite of a harmless snake.

The actual injection of rattlesnake venom into a wound is followed immediately by severe local pain in almost every case, and this should be used as a criterion in determining whether the bite is that of a rattler, and if venom has actually been injected. With most species a marked swelling is also evident within a very short time.

Assuming that a person has actually been bitten by a rattlesnake, the following procedure should be adopted by the victim and his companions, if any be present:

(1) The victim should not become unduly alarmed or excited, and should not run, for to do so will speed up the circulation and the rapidity with which the venom is absorbed. Remember that few cases of rattlesnake bite are fatal.

(2) Apply a tourniquet between the bite and the heart. This may be a shoe string, necktie, or a rubber band. Rubber tubing makes the

best tourniquet. Do not tie it too tightly. Complete stoppage of the circulation is unnecessary and undesirable, but the venous flow should be impeded. Loosen the tourniquet briefly at 15 minute intervals.

(3) With a sharp instrument, such as a razor blade or a knife, make a cross-incision over each fang mark, or connect the two with a single incision. The depth should be about equal to that of the fang, say a quarter of an inch if the snake is of moderate size. Before using, sterilize the cutting instrument if possible, using iodine, alcohol, or the flame of a match.

(4) Apply suction to the wound and the incisions thus made, either with the mouth or using one of the cupping or suction devices* which have been placed in first-aid kits for this purpose. Apply this continuously for at least half an hour. In a healthy person with good teeth there need be no fear of getting venom into the mouth or stomach with untoward results.

(5) If antivenin is available, use it in accordance with the instructions accompanying the syringe. However, do not depend upon it as a cure-all. Remember that antivenin and suction are not mutually exclusive; use antivenin if available, but the suction procedure should be carried through in any case.

(6) If swelling or discoloration progresses up the limb, additional cross incisions should be made above this point and suction should be applied there, the tourniquet having been moved above the swelling. It is best to put on a second tourniquet before removing the first.

(7) If the patient is faint, give a cup of strong coffee or a teaspoonful of aromatic spirits of ammonia in a glass of water.

(8) Get the patient to a doctor or hospital as soon as possible, securing a physician experienced in previous snake-bite cases if one be available.

(9) Do not do any of the following things: Do not use potassium permanganate. Do not give whiskey. Do not burn or cauterize the wound, since this will interfere with the all-important suction and drainage. Don't use "folk-lore" remedies; they are a waste of time when time is valuable.

(10) If the physician in charge of the case has not had previous experience he can secure advice from the United States Public Health Service by wire. The case should be closely watched for the first 24 and preferably the first 48 hours. Some cases have been lost because the decline in the prominent hemorrhagic symptoms (evidenced by local swelling and discoloration) seemed to indicate that the danger was past, to be followed by a sudden and unexpected onset of neurotoxic symptoms. It

* The rubber-bulb type is probably to be preferred since it will continue its action without an operator.

is suggested that physicians called upon to treat rattlesnake bite, study the publications of the United States Public Health Service, or those of Dr. Dudley Jackson of San Antonio, who has had a wide experience in this field; also the literature accompanying some of the suction devices now on the market in safety-first kits,* and the publications accompanying antivenin ampuls contain much useful information. It should be remembered, however, that these directions may be slightly biased as there has been some factional disagreement concerning the relative merits of antivenin and suction. I repeat that antivenin and suction are not mutually exclusive remedies; both should be used extensively in serious cases. The victim should always be typed so that a blood transfusion, if necessary, may be made without delay. Neurotoxic symptoms, frequently involving paralysis of the respiratory center, call for additional antivenin treatment The physician will use intravenous injections of glucose and normal salt solution as necessitated.

The carrying of kits containing suction devices (there are several good ones on the market) is to be recommended to campers, hunters, or others going into rattler infested country. This is said without any desire to frighten people or to exaggerate the chance of snake bite, which is indeed remote. It is, however, a reasonable insurance precaution.

The above brief remarks on the treatment of rattlesnake bite do no more than skim the surface. It must be remembered that most of the experience in this country has been in the treatment of cases of *C. cinereous* bite and that of closely allied species. Rattlesnake venom is an exceedingly complex protein poison, having a variety of effects, neurotoxic, hemolytic, cytolytic, anti-bactericidal, etc. These effects probably differ considerably in the several species. It is well known that the venom of *C. durissus* differs extensively in its effects from that of *C. cinereous* and some of our more common nearctic species. We may well expect that future research will show that others of our North American rattlers have quite different effects than has *C. cinereous*. This in turn may influence the development of antivenins and otherwise profoundly change the present recognized methods of treatment. Polyvalent antivenins cannot be made as effective as those to counteract the bite of specific snakes. Probably this is one of the reasons why Brazilian anticrotalus serum has been so successful; as there is but one species of rattlesnake in that country the antivenin is specific. In our country the situation is quite different. I anticipate that the future will see the venoms of our rattlers grouped in classes, with an antivenin for each class, although this could not be a successful commercial venture. In extensive areas of the country, where only one or two species of rattlers occur, only a single class would be required.

---

* The directions accompanying the Dudley First Aid Kit are particularly complete with respect to the procedure of the suction treatment, both in the field and hospital.

THE BITING MECHANISM OF THE RATTLESNAKE

Explanations of figs. 1 to 1n inclusive.

Fig. 1. Dorsal View of Skull of *Crotalus (C. ruber).*

The bones of the rattlesnake skull are thin and delicate. One of the distinguishing characters of snakes is the lack of a bony connection between the anterior ends of the mandibles, there being only an elastic ligament between these outer ends. This arrangement greatly facilitates the distension of the jaws, and by the independent action of the two sides, permits swallowing objects which are large relative to the size of the head.

Fig. 1a. Ventral View of Skull.

Note that the fangs are shown in the two outer maxillary sockets. This location is one of pure chance; with equal justification both might have been shown in the inner sockets, (see figs. 1g and 1h), or one in an inner and the other in an outer socket. As explained below, the fangs occupy the sockets alternately, and there is no synchronism in occupancy between the two sides of the head.

Fig. 1b. Lateral View of Skull.

The fang is folded against the roof of the mouth in its resting position. The lower jaw is dropped slightly, and the reserve fangs are omitted for clarity. This is not a cross section of the skull; it is a view of the outside from the left.

Fig. 1c. Lateral View of Skull.

The mouth is wide open and with the fangs directed forward in the position assumed at the end of the strike.

LEGEND: THE BONES OF THE RATTLESNAKE SKULL

(Figs. 1 to 1e, inclusive)

1. Prexamilla (premaxillary)
2. Prefrontal (lachrymal of some authors)
3. Frontal
4. Parietal
5. Basisphenoid
6. Squamosal (supratemporal of some authors)
7. Maxilla (maxillary or supermaxillary)
8. Palatine (palatal)
9. Pterygoid (internal pterygoid)
10. Ectopterygoid (external pterygoid or transpalatine)
11. Quadrate
12. Mandible (mandibular)
    12a Dentary
    12b Articular
13. Pro-otic
14. Exoccipital (lateral occipital)
15. Poison fang
16. Mandibular teeth
17. Pterygoid teeth
18. Palatine teeth
19. Supraoccipital
20. Stapes (or columella auris)
21. Postfrontal
22. Basioccipital
23. Nasal
24. Turbinal
25. Vomer

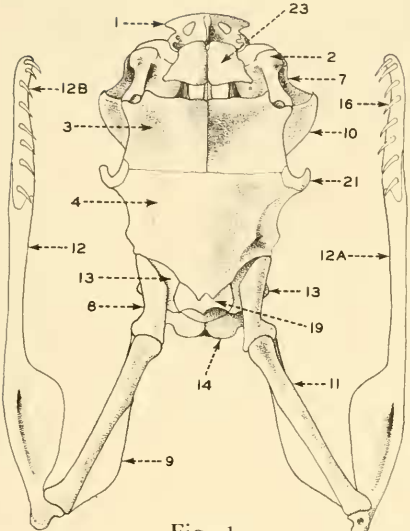

Fig. 1.

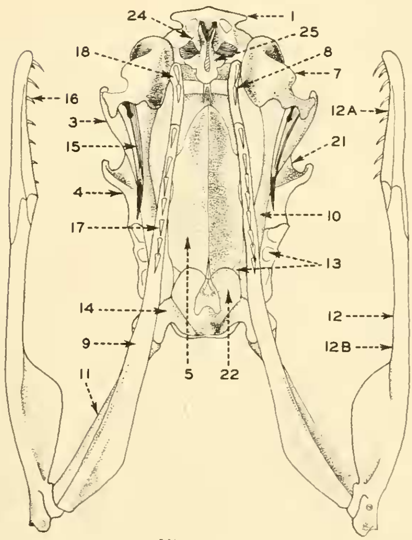

Fig. 1a.

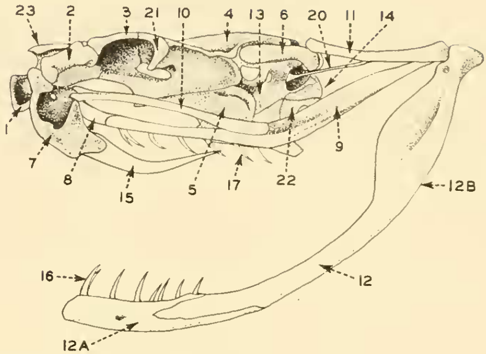

Fig. 1b.

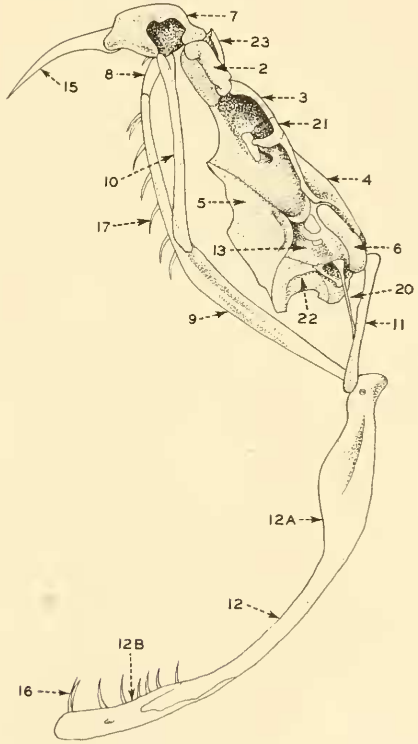

Fig. 1c.

Figs. 1d and 1e. The Fang Tilting Mechanism.

The bones of the skull are indicated as a linkage. Fig. 1d shows the fang at rest against the roof of the mouth; in fig. 1e the change in the angle between the frontal-parietal-supratemporal and the quadrate tilts the fang forward into the biting position by pushing forward on the maxillary. The fang is not rotated forward automatically by the opening of the mouth; the tilting is controllable, otherwise the fangs would interfere with swallowing food. Each fang may be tilted independently, as the bones on one side of the head are independent of those on the other.

Fig. 1f. Lateral View of Fang Seated in Maxillary.

Figs. 1g and 1h. Front View of Fang.

Fig. 1g shows a fang in the inner maxillary socket; in fig. 1h the next succeeding fang has been seated in the outer maxillary socket, while the fang shown in fig. 1g has dropped out. In this way succeeding active fangs occupy the two sockets alternately. (It should be noted that, because of the curvature of the fang, the lower part, in these figures, is viewed at an angle. This makes the orifice appear closer to the point than is really the case. See fig. 1i).

Fig. 1i. Point of Fang (Perpendicular view).

Figs. 1j and 1k. Cross Sections of Fang.

Fig. 1j shows a cross section of the fang at the upper end just below the lower edge of the maxillary in which it is anchored. Fig. 1k is a cross section just above the lower orifice.

Fig. 1l. Phantom Lateral View of Rattlesnake Head.

This illustrates the location of the venom gland and duct in relation to the fang.

Fig. 1m. The Position of the Reserve Fangs.

The reserve fangs do not tilt with the active fang but remain in place against the roof of the mouth.

Fig. 1n. Diagram Showing Fang Succession.

The two large circles represent the maxillary sockets, the left-hand being occupied by a functional fang. When this is ready to drop out, reserve fang No. 1 advances and becomes anchored in the vacant socket on the right. Later, when No. 1 is about to be superseded, No. 2 advances into the left-hand socket. Thus, the replacements are made periodically. New buds also appear periodically, so that, in all, about 8 reserves, in consecutive stages of development, are always present. The reserves which will ultimately be seated in the left-hand socket are separated from those intended for the right by a membranous wall. It should be understood that this discussion has had reference exclusively to the condition on one side of the upper jaw. There is a duplicate set of sockets and reserve fangs on the other side. In this diagram the reserve fangs have been spread out for reasons of clarity. Actually they lie closely bunched in a membranous sac above the active or functional fang, in the position indicated in fig. 1m.

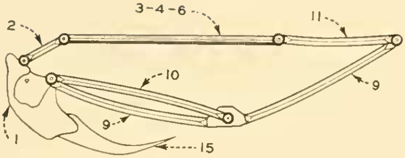

Fig. 1d.

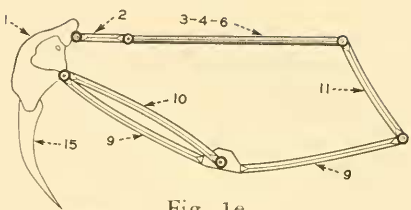

Fig. 1e.

Fig. 1f.

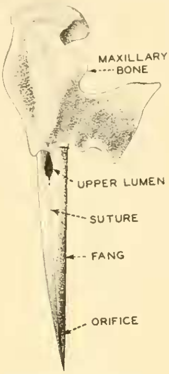

Fig. 1g.

Fig. 1h.

Fig. 1i.

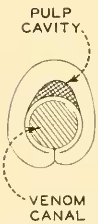

Fig. 1j.

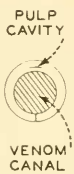

Fig. 1k.

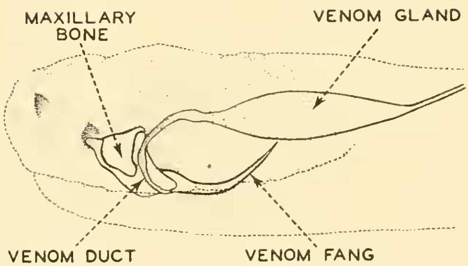

Fig. 1l.

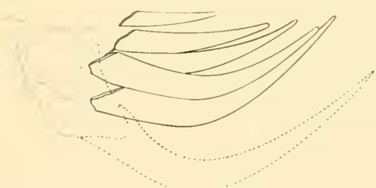

Fig. 1m.

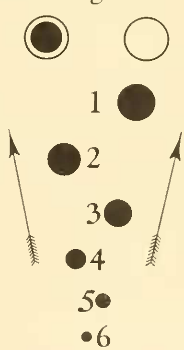

Fig. 1n.

GLOSSARY

While many users of this key will be familiar with the technical terms employed, such as the names of the scales used in herpetological classification, there may be others, especially physicians interested in snake-bite cases, who may not have had occasion to employ them. In addition there are certain peculiarities of the rattlesnakes which render it desirable to explain a few of the terms to those who have not worked in this group. For these reasons an illustrated glossary has been included.

Anal plate: The large plate covering the vent (fig. 3). It marks the division between body and tail.

Apical scale-pits: A pair of depressions faintly evident on the posterior end of each scale; usually most evident dorsally near the tail.

Body blotches: These are counted from the posterior edge of the head to the anus; the tail rings are not included. On the sides there are usually additional series of smaller blotches known as the lateral or secondary blotches, often in several rows, one below the other. In many species of rattlesnakes, especially on the posterior half or third of the body, the main dorsal blotches merge with the laterals to form crossbars or rings.

Button: See rattles.

Canthals: The border scales of the crown between the internasals and the supra-oculars (fig. 5). For intercanthals see prefrontals.

Canthus rostralis: The outer edge of the flat area of the crown where it turns downward on the side, extending from the rostral to the supraocular (fig. 5).

Caudals: See subcaudals.

Frontal: The large plate between the supraoculars in *Sistrurus* (fig. 4). In *Crotalus*, this space is filled with scales more or less irregularly disposed (fig. 5) and is referred to as the frontal area, and the scales as the inter-supraoculars. When the "minimum scales between the supraoculars" are specified, the path traversing the fewest scales is meant; this is usually at the anterior part of the frontal area.

Genials: The genials or chin-shields are a pair of enlarged scales back of the first infralabials (figs. 7 and 8). Occasionally the posterior tips of the first infralabials are cut off to form an extra pair of triangular scales which are called intergenials (fig. 46). Snakes other than rattlesnakes often have two pairs of genials, an anterior and posterior.

Gulars: The small scales covering the underside of the head between the two rows of infralabials and not otherwise specifically named (fig. 8).

Head marks: Although there is a considerable variation in the head marks of the rattlesnakes there are some which occur in many species; these are indicated as to general position and direction in figs. 9 and 10. The light supraocular crossbars in some species are present only on the supraoculars and not in the intervening frontal area.

Infralabials: See labials.

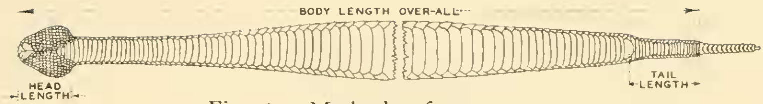

Fig. 2. Methods of measurement.

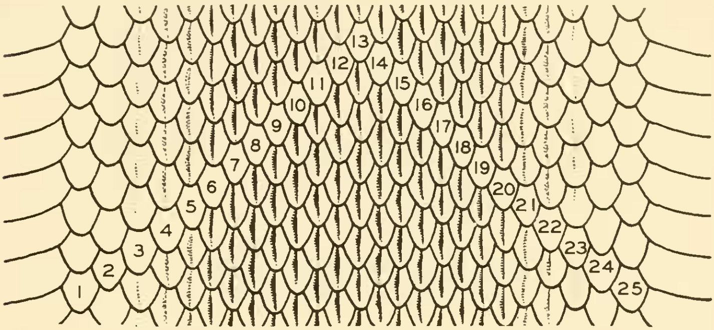

Fig. 2a. Method of counting dorsal scale rows.

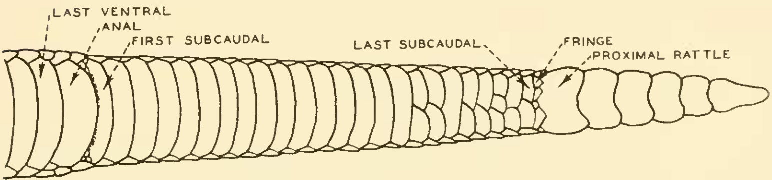

Fig. 3. Ventral view of tail with nomenclature.

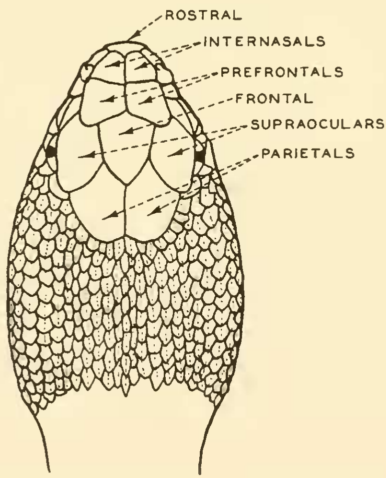

Fig. 4. Nomenclature of head scales of *Sistrurus*.

Intercanthals: See prefrontals.

Internasals: The scales in contact with the rostral from nasal to nasal regardless of size (figs. 4 and 5). In most rattlesnakes there are two; in *viridis* generally three or more (fig. 49).

Intersupraoculars: See frontal.

Labials: Bordering the mouth above are the supralabials (or upper labials) which extend from the rostral to the rictus of the mouth or commissure (figs. 6 and 7). The rostral is not counted as one of the supralabials. Similarly the infralabials (lower labials) extend along the lower lip from the mental to the angle of the mouth (figs. 6, 7, and 8). The first pair of infralabials are sometimes divided transversely (fig. 42).

Lengths: The length over-all (or body length) is measured from the tip of the snout (rostral) to the forward edge of the proximal rattle (fig. 2). Head length is measured from the rostral to a line joining the posterior tips of the mandibular bones. Tail length is from the anus to the forward edge of the proximal rattle.

Loreals: The scales (one or more) on the side of the head between the postnasal and the preocular (fig. 6). No species of rattlesnake is regularly without at least one loreal on each side, although rarely an individual will have none.

Mental: The triangular scale at the anterior tip of the lower jaw (figs. 7 and 8). Occasionally the posterior tip of the mental may be cut off to form a submental (fig. 47).

Nasals: A pair of scales on either side of the nostril, called respectively, the prenasal and postnasal (figs. 6 and 7).

Oculars: The scales surrounding the eye. The supraoculars are large and jut over the eyes (fig. 6). In front of the eyes there are usually two preoculars, the upper larger, the lower narrow and crescent shaped. Back of, and below the eye, are the postoculars and suboculars. It is usually difficult to determine which scale should be considered the lowest postocular, and which the first subocular.

Parietals: A pair of large plates posterior to the supraoculars and frontal in *Sistrurus* (fig. 4). This area is occupied by irregular scales in *Crotalus* (fig. 5).

Pit: A deep depression on the side of the head below and back of the nostril (fig. 6); this is the external opening of a sensory organ, probably auditory in function. Where the pit-border scales are mentioned, those constituting the internal rim or lip are meant, rather than those which are completely external to the pit.

Postnasals: See nasals.

Postoculars: See oculars.

Prefrontals: In *Sistrurus* the two large plates posterior to the internasals (fig. 4). In *Crotalus*, with a few exceptions of which *durissus* is an example, this space (often referred to as the prefrontal area) is filled with irregularly disposed scales called the intercanthals (fig. 5).

Prenasals: See nasals.

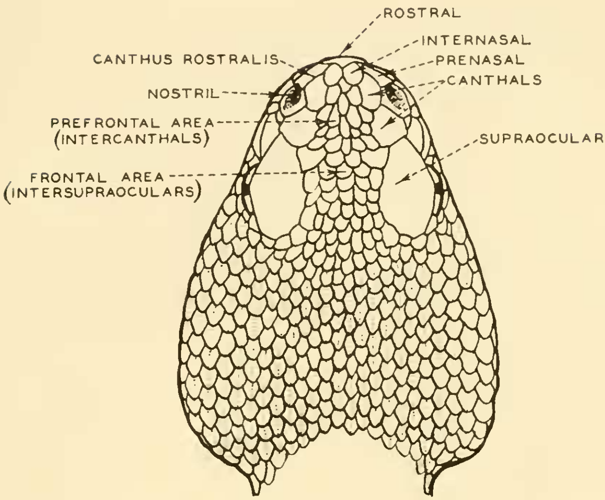

Fig. 5. Nomenclature of head scales of *Crotalus,* dorsal view.

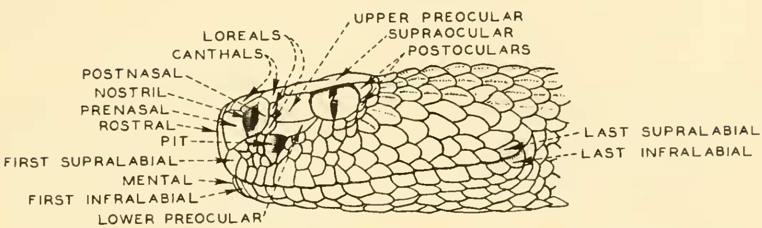

Fig. 6. Nomenclature of head scales of *Crotalus,* lateral view.

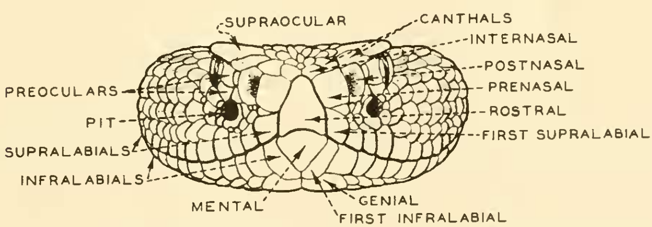

Fig. 7. Nomenclature of head scales of *Crotalus,* front view.

Preoculars: See oculars.

Rattles: The rattle terminology is illustrated in figs. 11 and 12. The proximal rattle is that next the tail and is the one most recently added to the string. The button (or rattle-button) is the first permanent rattle acquired by a young snake, the rattle present at birth (the prebutton) being invariably lost with the first exuviation. The button remains as the posterior terminus of the rattle-string until lost by breakage; it is usually present in juveniles or young adults, but rarely in older specimens. In some snakes, particularly if only one or two rattles have been lost, it is a trifle difficult to tell whether the button is still present; however this can be ascertained quite definitely with a little practice in the study of juvenile termini. The rattle width of any segment is measured as indicated in fig. 12. It is to be noted that the measurement (to secure the greatest width) is not exactly vertical, this being the result of the asymmetry in the rattle shape designed to prevent the rattle from dragging on the ground as the snake crawls. In this key the widths of the proximal rattle and the button are occasionally used.

Rostral: The large scale on the front of the nose (figs. 4, 5, 6 and 7).

Scale-boss: A knobby prominence or swelling on the posterior part of each scale, particularly evident on the middorsal rows of some species. It is to a certain extent independent of the keeling (or central ridge on each scale) which is present on all but the one or two lowest dorsolateral rows in all rattlesnake species.

Scale rows: Where the number of dorsal scale rows is given, the number at mid-body is meant, beginning with the row next to the ventrals on one side and ending with the corresponding row on the other (fig. 2a). Occasionally the scale rows at the center of the tail are referred to; these should be counted midway between the anal plate and the anterior edge of the proximal rattle.

Subcaudals: The subcaudals (caudals or urosteges) are counted beginning with the first scale on the mid-ventral line posterior to the anal plate and ending with the last scale anterior to the proximal rattle (fig. 3). Divided scales, that is, those having mid-ventral sutures, frequently found toward the beginning or end of the series, are treated as if undivided. The fringe of small and irregular scales which occasionally covers the anterior edge of the rattle is not counted as a caudal.

Supralabials: See labials.

Supraoculars: The large plates above each eye (figs. 4, 5, 6 and 7). Also see oculars.

Suture: A division or crease between two scales or plates, or the parts of a plate.

Tail rings: The dorsal rings between the anus and the proximal rattle. They are often obscure and can only be counted approximately.

Ventrals: The large plates on the belly. In counting the ventral plates (sometimes called the gastrosteges) the count is begun with the first scale on the underside of the head which is distinctly wider than long (fig. 8), and ends with the scale anterior to the anal plate, but does not include the the latter (fig. 3).

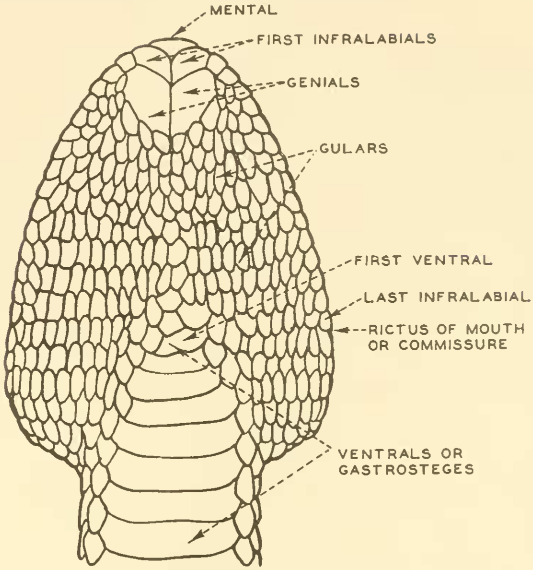

Fig. 8. Nomenclature of head scales of *Crotalus,* ventral view.

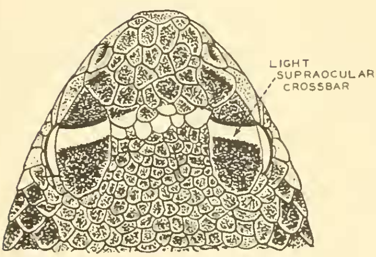

Fig. 9. Head pattern of *Crotalus.* dorsal view.

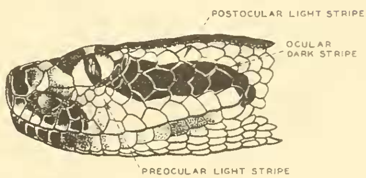

Fig. 10. Head pattern of *Crotalus,* lateral view.

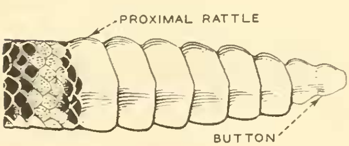

Fig. 11. Complete rattle with button.

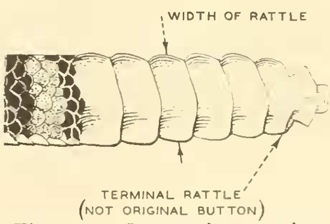

Fig. 12. Incomplete rattle.

METHOD OF EMPLOYING THE KEY

Start at 1 and decide whether the specimen to be identified is correctly described by paragraph 1a or by 1b. If the former be the case, the snake belongs to the genus *Sistrurus;* if the latter, to the genus *Crotalus*. Assume, in this instance, that it is a *Crotalus*. Note that the bold-faced figure 7 appears at the end of the final line in paragraph 1b; this is an instruction to proceed to the paragraphs headed 7a and 7b. Now decide which of these alternative descriptions fits the specimen in hand. If it fits description 7a, note that the bold-faced figure 8 appears at the end of the last line of the description; you are therefore next to choose between paragraphs 8a and 8b. If, on the contrary, course 7b is found to be the proper one, then the specimen is *Crotalus stejnegeri* and the identification is concluded. Thus by successive selections of one of pairs of alternatives a final decision is reached.

When an identification has been made it is recommended that the color description, the range, and the photograph (if one is given) be also checked against the specimen and its data, so that an inaccurate conclusion may be avoided, even if some peculiarity of the specimen, or ambiguity in the key, has caused a wrong turning at one of the branch points. The table of scale counts may also serve as a check.

It should be observed, with reference to the line drawings in the text (figs. 1–64), that the stippling is usually not for the purpose of indicating punctations in the pattern of the snake but more often serves to suggest the even application of some color other than black.

* * * * * * * *

The writer will welcome correspondence with users of this key calling his attention to errors or discrepancies. New locality records, especially if verified by live or preserved specimens (heads or skins are usually sufficient for identification), will be much appreciated in order that the range maps may be more accurate in future publications.

ACKNOWLEDGMENTS

To the many persons and institutions which have assisted me by the gift and loan of specimens during this investigation of the rattlesnakes I shall make acknowledgments in subsequent papers. At this time however I wish to give credit for the line drawings in this key to Mr. Norman Bilderback, and for the photographs, maps, and also the lettering on the drawings to Mr. Leslie C. Kobler, both of San Diego.

KEY

1 a. Top of head with large plates anteriorly (usually 9 in number) including a single frontal and a pair of large, symmetrical parietals in contact (fig. 13).* **Genus Sistrurus 2**

1 b. Top of head with scales of varying size; more than one scale in the frontal area; parietals, if enlarged, not in contact, nor symmetrical (fig. 14). **Genus Crotalus 7**

2 a. Rostral not curved over the snout (fig. 15); canthus rostralis sharply angled; dorsal series of body blotches about equal in width and length, or shorter (along the snake) than wide. 3

2 b. Rostral curved over the snout (fig. 16); canthus rostralis rounded, not sharply angled; dorsal series of body blotches distinctly longer than wide (fig. 17). A pattern of dark-brown blotches on a light-brown ground-color, with a lateral series on each side shorter (longitudinally) and usually darker than the dorsal series. **Sistrurus ravus**

A small area of the Mexican plateau including: eastern México (state), southern Hidalgo, Tlaxcala, northeastern Puebla, west-central Veracruz, and northern Oaxaca (fig. 73).

3 a. Upper preocular usually in contact with postnasal; usually 3 supralabials in contact with the pit-border scales (fig. 15); 11 or more dorsal scale rows at center of tail; rattles larger, width of proximal rattle being contained in body length (over-all) less than 90

* Deviations of snakes of the genus *Sistrurus* from the standardized arrangement of the nine large plates on the crown (as illustrated in fig. 13) are not particularly rare, but such deviations usually consist of small and insignificant extra scales detached from the posterior end of the frontal or, less often, from the rostral. It is quite rare to find the nine large plates themselves seriously distorted in arrangement, although specimens have been noted with a central prefrontal and a canthal on either side. None of these aberrant specimens will be confused with any *Crotalus* individual if the criteria given in the key be followed, for although there are *Crotalus* species (*durissus* for example) which have large paired internasals and prefrontals (fig. 56), they lack the single frontal, and the paired and conterminous parietals of *Sistrurus*.

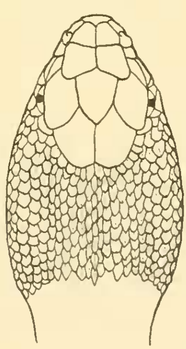

Fig. 13. Dorsal head plates of *Sistrurus (S. c. catenatus)*.

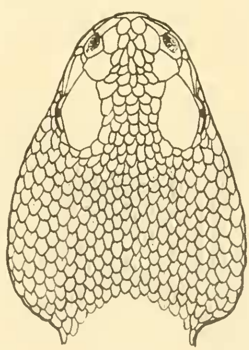

Fig. 14. Dorsal head scales of *Crotalus (C. cinereous)*.

times, or in head length less than 6 times; no red or orange in the interblotch spaces on the middorsal line. **Sistrurus catenatus**

(For subspecies continue on to 4)

3 b. Upper preocular not in contact with postnasal; usually 2 supralabials in contact with pit-border scales (fig. 18) ; 10 or less dorsal scale rows at center of tail; rattles smaller, width of proximal rattle being contained in body length more than 90 times, and in head length more than 6 times; usually with red or orange between the blotches on the middorsal line. **Sistrurus miliarius**

(For subspecies continue on to 5)

4 a. Undersurface dark, heavily clouded with black blotches, often almost solid black (fig. 19) ; scale rows usually 25; body blotches usually less than 37. A pattern of square, red-brown, or black blotches on a gray-brown ground; sometimes unicolor black. **Sistrurus catenatus catenatus**

(Fig. 106).

From central New York westward to eastern Oklahoma including: New York from Madison County west; southern Ontario, south and west of the line Spanish—North Bay—Port Hope; extreme western Pennsylvania; northern and central Ohio; lower Michigan (including Bois Blanc Island) ; central and northern Indiana; Illinois; southern and western Wisconsin; eastern and southern Iowa; extreme southeastern Nebraska; Missouri; eastern Kansas and eastern Oklahoma, intergrading here with *S.c. tergeminus* (fig. 73).

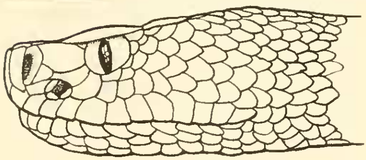

Fig. 15. *S. c. catenatus,* showing rostral not curved over snout; also preocular contacting postnasal.

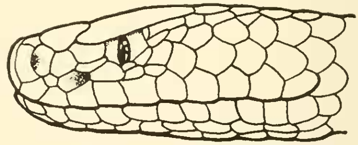

Fig. 16. *S. ravus,* showing rostral curved over snout.

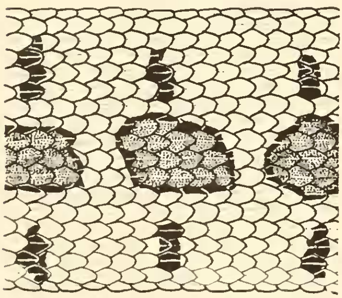

Fig. 17. *S. ravus;* body pattern.

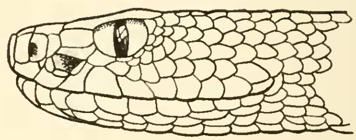

Fig. 18. *S. miliarius,* showing preocular separated from postnasal.

4 b. Undersurface mottled or spotted, the dark areas being less extensive than the light (fig. 20); scale rows often 23; body blotches usually more than 36. A pattern of dark red-brown blotches on a gray-brown ground. **Sistrurus catenatus tergeminus** *(Fig. 107).*

The southwestern plains including: central and southwestern Kansas; extreme southeastern Colorado; central and western Oklahoma; the plains areas of central and southern New Mexico; extreme southeastern Arizona; Texas, west of the Brazos River; and extreme northern Tamaulipas, Mexico. Intergrades with *S.c. catenatus* in eastern Kansas and Oklahoma (fig. 73).

5 a. Dorsal coloration brown or light-gray; ventral surface cream, moderately flecked with brown or gray; head markings distinct; lateral spots in 1 or 2 series. 6

5 b. Dorsal coloration dark-gray to black; ventral surface white, heavily blotched with dark-brown or black; head markings obscure; lateral spots in 3 series. **Sistrurus miliarius barbouri** *(Fig. 104).*

From extreme southern South Carolina (where it intergrades with *S.m. miliarius*) and southern Georgia, south throughout Florida and westward across southern Alabama to southeastern Mississippi, intergrading with *S.m. streckeri* in the Pearl River Valley (fig. 73).

6 a. Dorsal scale rows usually 21; dorsal spots wider than long and with irregular edges; lateral spots usually higher than wide; ventral spots confined to individual plates. **Sistrurus miliarius streckeri** *(Fig. 105).*

From the Pearl River Valley of southeastern Louisiana and western Mississippi (where it intergrades with *S.m. barbouri*) westward through Louisiana and eastern Texas (north of Lat. 28°) to Long. 98°; also north through Arkansas to southern Missouri and west to central Oklahoma; also southwestern Tennessee (fig. 73).

6 b. Dorsal scale rows usually 23; dorsal spots oval or subcircular, edges even; lateral spots usually round; ventral spots usually occupying two adjacent plates. **Sistrurus miliarius miliarius** *(Fig. 103).*

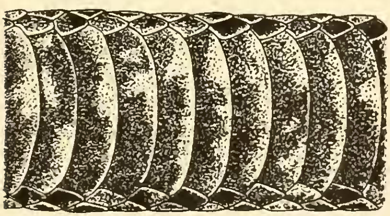

Fig. 19. *S. c. catenatus;* ventral pattern.

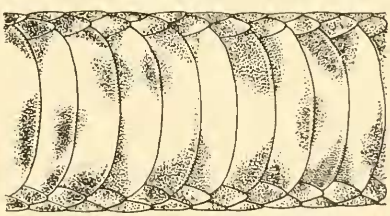

Fig. 20. *S. c. tergeminus;* ventral pattern.

From extreme southern South Carolina (where it intergrades with *S.m. barbouri*) north throughout South Carolina and eastern North Carolina to the Pamlico River. Also central Georgia and central Alabama (fig. 73).

7 a. Males with less than 40 subcaudals; females with less than 35 subcaudals; adults with proximal rattles wider than 3½mm. 8

7 b. Males with more than 40 subcaudals; females with more than 35 subcaudals; rattles very small, width less than 3½ mm. in adults. A pattern of about 40 black-edged, olive-gray diamonds on a gray-brown ground. **Crotalus stejnegeri**

The mountains of southeastern Sinaloa and western Durango in Mexico (fig. 71).

8 a. Outer edges of supraoculars not extended into raised and flexible hornlike processes (fig. 21). 9

8 b. Outer edges of supraoculars extended into raised and flexible hornlike processes distinctly pointed at the tip (figs. 22 and 23). Dorsal scales strongly keeled and with posterior bosses. Ground color cream, straw, pink, or light-gray, with a central series of square, brownish blotches, often with yellow or orange on the middorsal line. **Crotalus cerastes** *(Fig. 95).*

The deserts of the southwest including: California east of the Sierra Nevada and the southern California coastal ranges, from Lat. 37°30′ southward; Nevada south of Lat. 37°30′; west-central and south-western Utah; Arizona south and west of the line Kingman—Miami—Nogales; extreme northwestern Sonora; the transmontane desert area of northeastern Baja California from the U. S. border south to Lat. 29°40′ (fig. 71). A species preferring sandy deserts but sometimes found on rock-strewn flats. (Note: In the Southwest the range of *cerastes* is popularly supposed to be considerably more extensive than

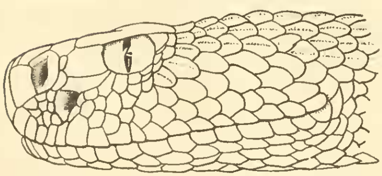

Fig. 21. Lateral head scales of *Crotalus (C. cinereous).*

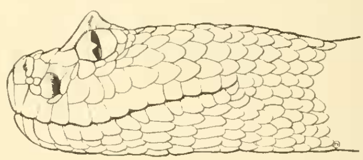

Fig. 22. *C. cerastes,* showing hornlike supraocular (lateral view).

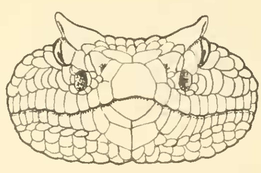

Fig. 23. *C. cerastes* (front view).

is here depicted, since in many areas all young rattlesnakes are termed "sidewinders", leading to confusion with the real *cerastes.* While further collecting may be expected to develop some range extensions, this most highly specialized of our desert snakes cannot possibly exist in some areas where it has been said to occur, but from which no authentic specimens have ever been forthcoming).

9 a. Tip of snout and canthus rostralis not raised into a sharp ridge (fig. 24) ; no central light line on rostral and mental. **10**

9 b. Tip of snout and canthus rostralis raised into a sharp ridge, by bending up of the outer edges of internasals and canthals (fig. 25) ; rostral and mental usually marked vertically by a narrow, light line on a red-brown ground (fig. 26). Body pattern of large, brown or red-brown blotches separated by narrow light areas, the blotches being often without definite outlines on the sides; tail pattern terminating in logitudinal bands rather than crossbars. **Crotalus willardi**
(Fig. 102).

Highland areas from extreme southern Arizona to Zacatecas, Mexico including: the Santa Rita and Huachuca mountains in Arizona; and the Sierra Tarahumare and Sierra Madre in eastern Sonora, western Chihuahua, Durango, and western Zacatecas (fig. 72).

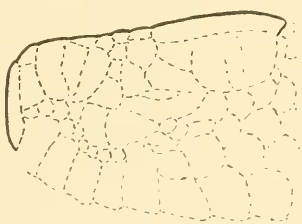

Fig. 24. Cross-section of *Crotalus* head *(C. m. mitchellii),* showing absence of internasal ridge.

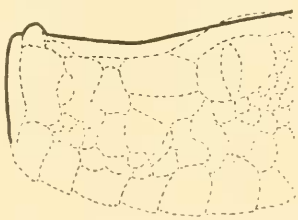

Fig. 25. Cross-section of *C. willardi* head, showing internasal ridge.

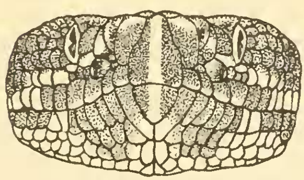

Fig. 26. Head of *C. willardi,* showing light line usually present on rostral and mental.

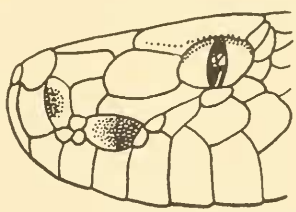

Fig. 27 *C. polystictus,* showing indentation on upper edge of prenasal.

10 a. Head width usually greater than 60 per cent of the length; prenasal not deeply indented by a lateral bulge in the first canthal (fig. 21); paired intercanthals, if present, not distinctly longer than wide. **11**

10 b. Head long and narrow, maximum width less than 60 per cent of length; prenasal deeply indented by a lateral bulge in the first canthal (fig. 27); paired intercanthals longer than wide (fig. 28); usually 8 scales in two transverse rows on top of the head anterior to the supraoculars and intersupraoculars (maximum variation 6 to 10); dorsal pattern usually of parallel rows of dark-brown elliptical blotches, the major axes of which are longitudinal to the snake and with narrow gray-brown interspaces (fig. 29); ventral surface heavily mottled with dark-brown or black. **Crotalus polystictus**

The tableland of central Mexico from Zacatecas to Oaxaca including: southern Zacatecas, eastern Jalisco, Guanajuato, Michoacán, Distrito Federal, west-central Veracruz, Oaxaca, and probably the intervening states of Aguascalientes, Querétaro, Hidalgo, México, Morelos, Tlaxcala, and Puebla (fig. 69). Unverified reports from southern Jalisco and eastern Colima.

11 a. No paired dark vertebral stripes on the neck; or if present, not extending as much as 1½ head-lengths before meeting the first dorsal blotches; vertebral process less sharp and prominent; dorsal scales without such prominent posterior bosses.* **13**

11 b. A pair of dark vertebral stripes 1 to 3 scales wide on the neck, bounding a lighter middorsal stripe about 3 scales wide, and extending posteriorly 1½ head-lengths or more before meeting the first dorsal blotches; spinous process sharp and ridge-like; posterior head scales and dorsal scales strongly keeled and with conspicuous posterior bosses; usually with only 4 and rarely with more than 6 large flat scales on the crown anterior to the supraoculars and intersupraoculars. **Crotalus durissus**

(For subspecies continue on to 12)

* There are rare instances of paired vertebral stripes in *viridis;* these can readily be differentiated from *durissus* by the presence of more than 6 scales in the internasal—prefontal area. Similarly occasional specimens of *durissus* occur in which the characteristic anterior paravertebral stripes are replaced by blotches. As far as we now know any rattlesnake from Central or South America should be classified as *durissus,* except that *unicolor* may occur in Nicaragua.

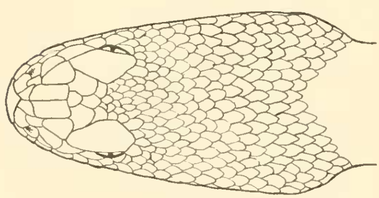

Fig. 28. *C. polystictus,* showing paired and elongated intercanthals.

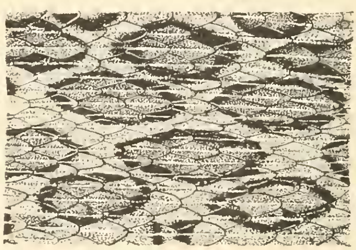

Fig. 29. Dorsal pattern of *C. polystictus.*

12 a. Light scale rows (one scale wide), laterally bounding the dark paravertebral stripes (or dorsal blotches) in strong color-contrast with the next scales below on the sides (fig. 30). A pattern of brown dorsal diamonds on a brown ground color, without strong contrast between the dorsal and lateral areas.

Crotalus durissus terrificus

(Fig. 75).

South America and eastern Central America including: Argentina, Uruguay, Paraguay, Brazil, Bolivia, eastern Peru, eastern Ecuador, the Guianas, Venezuela, Colombia, and central and eastern Costa Rica where there is intergradation with *C. durissus durissus* (figs. 65 and 66). Presence in Panama and Canal Zone somewhat doubtful.

12 b. Light scale rows (one scale wide), laterally bounding the dark paravertebral stripes (or dorsal blotches) but little or no lighter than the lateral areas next below (fig. 31). A pattern of dark-brown or black dorsal diamonds (usually with light centers) in strong contrast to the cream, yellow, gray, or light-brown ground color of the sides. **Crotalus durissus durissus**

(Fig. 74).

Southern Mexico and Central America including: the Mexican states of Michoacán, Guerrero, Distrito Federal, central Puebla, central and southern Veracruz, Oaxaca, Tabasco, Chiapas, Campeche, Yucatán, and probably also Morelos, México, Tlaxcala, and Quintana Roo; Guatemala, British Honduras, Honduras, El Salvador, and Nicaragua (fig. 66). The area of intergradation with *C. durissus terrificus* seems to be approximately central Costa Rica, although the change is so gradual that specimens between Honduras and Panama may be difficult to allocate, the pattern being somewhat dependent on altitude.

13 a. Upper preocular not split vertically; or, if split,* the anterior section not conspicuously higher than the posterior and not curved over the canthus rostralis in front of the supraocular; prenasal not

* As is frequent in *mitchellii* and occasional in *triseriatus*.

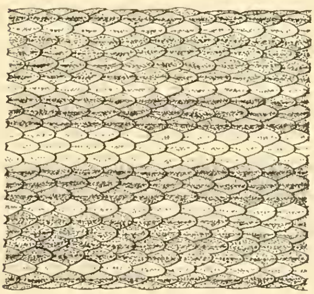

Fig. 30. Dorsal neck pattern of *C. d. terrificus.*

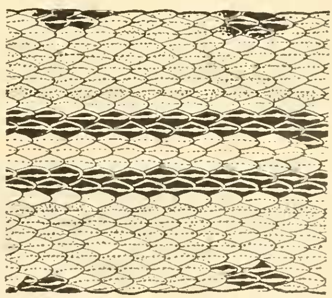

Fig. 31. Dorsal neck pattern of *C. d. durissus.*

curved under the postnasal (fig. 21); the pattern not of widely separated crossbars or rings. **15**

13 b. Upper preocular split vertically, the anterior section being higher than the posterior and curved over the canthus rostralis in front of the supraocular; prenasal curved under the postnasal (fig. 32); usually a pattern of widely separated crossbars (fig. 33).

Crotalus lepidus

(For subspecies continue on to 14).

14 a. A dark stripe passing backward from the eye to the angle of the mouth (fig. 32); dorsal pattern of crossbars often not strongly differentiated from the ground color; ventral surface mottled. A pattern of 13 to 22 brown or black blotches or crossbars on a punctate background of gray, brown, or pink flecked with gray, the blotches being separated by a much greater distance (neglecting rudimentary* or obsolescent blotches which are often present) than the longitudinal extent of the blotches; tail usually pink or reddish, crossed by 4 or less widely separated brown rings.

Crotalus lepidus lepidus

(Fig. 98).

West Texas and northeastern Mexico including: the trans-Pecos region of Texas (especially the Davis and Chisos mountains, but excluding the El Paso area, where it is replaced by *C.l. klauberi*), and Valverde, Real, and Maverick counties; Coahuila, northern San Luis Potosí, and probably northern Zacatecas (fig. 69).

14 b. No dark postocular stripe; dorsal pattern of crossbars sharply contrasting with the ground color; ventral surface punctated. A pattern of 14 to 21 dark reddish-brown, or black blotches, or crossbars on a background of green, blue-green, or blue-gray, the blotches being separated by a much greater distance than their longitudinal extent (fig. 33); tail usually cream or pink, crossed by 4 or less widely separated brown rings. A subspecies preferring mountains. **Crotalus lepidus klauberi**

(Fig. 99).

Southeastern Arizona, southern New Mexico, the El Paso area in Texas, and north-central Mexico including: the Santa Rita, Huachuca,

* Occasionally these are almost as evident as the fundamental bars thus producing a pattern of closely adjacent bands.

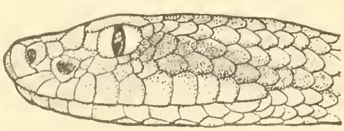

Fig. 32. *C. l. lepidus,* showing split upper preocular and prenasal curved under postnasal.

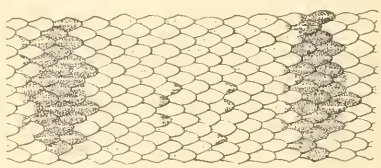

Fig. 33. *C. l. klauberi;* dorsal pattern.

Dragoon, and Chiricahua mountains of southeastern Arizona; the Franklin, Magdalena, Pinos Altos, Mimbres, Animas, Big Hatchet, and Dog mountains of southern New Mexico; El Paso County, Texas; and mountain areas in the Mexican states of Chihuahua, Durango, southern Zacatecas, Aguascalientes, eastern Nayarit, and northern and eastern Jalisco (fig. 69).

15 a. Prenasals in contact with rostral (fig. 34); upper preocular not divided, or if divided (as in a few *triseriatus*), the loreal conspicuously longer than high. **17**

15 b. Prenasals usually separated from the rostral by small scales or granules (fig. 35); upper preoculars often divided, horizontally, vertically, or both (fig. 36); rostral usually wider than high; a pattern of dorsal blotches essentially comprising aggregations of punctations. **16**

16 a. Head smaller; length of head contained in adult body length more than 24 times; original rattle-button (fig. 11), if present, more than 7.5 mm. wide. A pattern of dark-gray or brown, punctated blotches on a gray or tan background.

Crotalus mitchellii mitchellii *(Fig. 91).*

Distrito del Sur of Baja California, Mexico, intergradation with *C. mitchellii pyrrhus* occurring approximately along the border of the two districts; also the islands of Ceralvo, Espíritu Santo, San José (Gulf Coast), and Santa Margarita (Pacific Coast). Fig. 69.

16 b. Head larger; length of head contained in adult body length less than 24 times; original rattle-button, if present, less than 7.5 mm. wide. A pattern of red, gray, brown, or black, punctated blotches on a cream, tan, buff, gray, pink, salmon, fawn, or brown back-

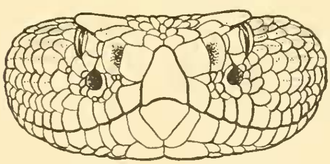

Fig. 34. Head scales of *Crotalus;* front view *(C. cinereous).*

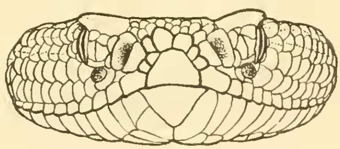

Fig. 35. *C. m. pyrrhus;* front view, showing separation of rostral from prenasals; also rostral wider than high.

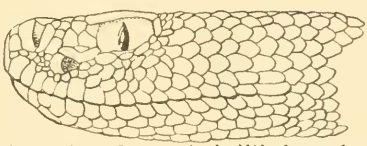

Fig. 36. *C.m. mitchellii;* lateral view showing split upper preocular.

ground; often with posterior black tips on some dorsal scales between blotches. **Crotalus mitchellii pyrrhus** *(Fig. 92).*

Southern California, western Arizona, and northern Baja California including the following: California south of the line Barstow—Ivanpah (approximate line of intergradation with *C.m. stephensi*) and east of Long. 118° (but absent from the San Gabriel Mountains and the coastal plain); the southern tip of Nevada; Baja California south to the northern boundary of Distrito del Sur (where intergradation with *mitchellii mitchellii* is to be expected); Isla Angel de la Guarda; extreme northwestern Sonora; west-central and southwestern Arizona, inside the line Peach Springs—Williams—Casa Grande—Ajo (fig. 69). A species preferring rocky habitats.

17 a. Tail of alternating black, and light ash-gray rings, both colors being in sharp contrast with the posterior body color (fig. 37), which may be gray, dark-gray, cream, pink, red, red-brown, or olive-brown.* **18**

17 b. Tail not of alternating black, and light ash-gray rings in strong color-contrast to the body color immediately anterior to the tail. **23**

18 a. Dark and light tail rings of approximately equal width (fig. 37); postocular light stripe, if present, intersects the supralabials from 1 to 3 scales anterior to the angle of the mouth (fig. 38); minimum scales between supraoculars 3 or more (fig. 14); no definite line of demarcation between the scales in the frontal and prefrontal areas; proximal rattle black. **Cinereous group 19**

* Many other species of rattlers have barred tails but it is characteristic of the *cinereous* group that there is a sharp transition in color at the beginning of the tail, whereas in the others there is no sharp contrast between the posterior body rings and the anterior tail rings. The *cinereous*-type tail has the appearance of having been attached to the wrong snake.

Fig. 37. Tail pattern of *cinereous* group.

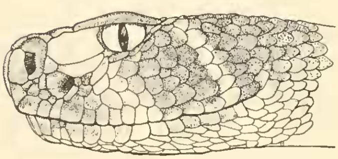

Fig. 38. *C. cinereous;* lateral head marks.

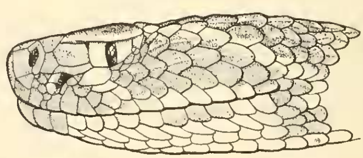

Fig. 39. *C. scutulatus;* lateral head marks.

18 b. Dark tail rings narrower than light; postocular light stripe, if present, passes backward above the angle of the mouth (fig. 39); minimum scales between the supraoculars rarely more than 2; a definite division line or suture between the scales in the frontal and prefrontal areas (fig. 40); lower half of proximal rattle light in color. A pattern of brown hexagons or diamonds on a green, olive-green, or brown background; light scales bordering the dark diamonds are unicolor, it being characteristic of this species that the blotch edges follow the scales and do not cut them.

Crotalus scutulatus

(Fig. 84).

From the Mojave Desert in California southeastward to south-central Mexico including: Kern, Los Angeles (Antelope Valley), and San Bernardino counties in California but only eastward of the Tehachapi, San Gabriel, and San Bernardino mountains; the desert valleys of Lincoln and Clark counties, Nevada; extreme southwestern Utah; Arizona south and west of the line Williams—Safford; extreme southwestern New Mexico; trans-Pecos Texas; northeastern Sonora, Chihuahua, eastern Durango, southern Coahuila, southwestern Tamaulipas, Zacatecas, San Luis Potosí, and southeastward at least to Tlaxcala, no doubt including the intervening Mexican plateau states of Guanajuato, Querétaro, and Hidalgo (fig. 66).

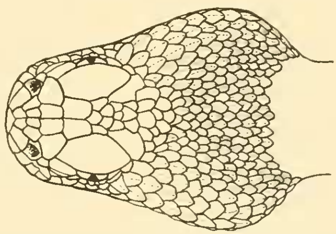

Fig. 40. Dorsal head scales of *C. scutulatus* showing paired intersupraoculars.

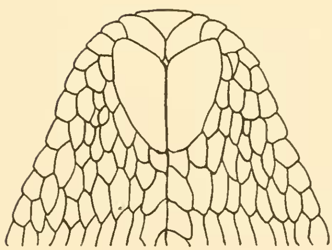

Fig. 41. Chin shields of *Crotalus;* first infralabials undivided.

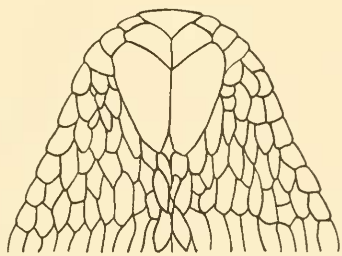

Fig. 42. Chin shields of *Crotalus*; first infralabials divided.

19 a. First infralabials usually not divided transversely (fig. 41) ; general color cream, buff, gray, or gray-brown (sometimes pink or red in central Arizona or New Mexico) ; dark punctations conspicuous in markings. **20**

19 b. First infralabials usually divided transversely (fig. 42) ;* general color pink, red, brick-red, red-brown, or olive-brown; dark punctations weakly in evidence or absent from markings. **21**

20 a. Upper preocular usually not in contact with the postnasal and no upper loreal present (fig. 43) ; head smaller in proportion to body. Pattern of dark-brown, punctated diamonds with lighter centers on a gray background, and with light borders of the diamonds often absent laterally. **Crotalus tortugensis** *(Fig. 81).*

Tortuga Island in the Gulf of California (fig. 67).

20 b. Upper preocular usually in contact with the postnasal (fig. 44), or such contact prevented by an upper loreal (fig. 45) ; head proportionately larger. Pattern of brown dorsal diamonds consisting

* A considerable proportion of California *cinereous* have divided first infralabials and one must employ the pattern criteria to judge California specimens or he will be improperly led to course 21 instead of 20. The blotches of *cinereous* are always strongly punctate, those of *ruber* almost unicolor.

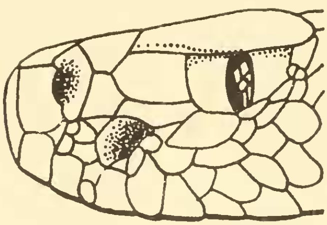

Fig. 43. Snout of *Crotalus;* no contact between postnasal and preocular.

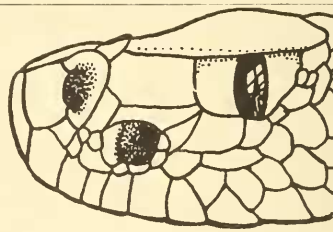

Fig. 44. Snout of *Crotalus;* contact between postnasal and preocular; also between prenasal and first supralabial.

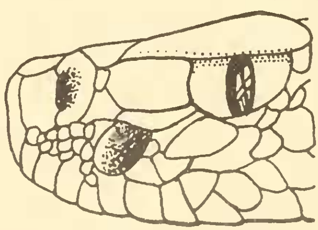

Fig. 45. Snout of *Crotalus;* upper loreal present; no contact between prenasal and first supralabial.

of aggregations of punctations on a cream, buff, gray, gray-brown, or (rarely) reddish background. **Crotalus cinereous**
(Figs. 80 and 108).

From Arkansas and Texas south to central Mexico and west to California including the following: extreme southeastern Missouri; northeastern, central, and west-central Arkansas; western and southern Oklahoma; Texas (except the Panhandle and east of Long. 95°); New Mexico south of Lat. 36° but not including the mountains of the central-west; Arizona south and west of the line Ash Fork—Clifton; the southern tip of Nevada; the desert areas of Riverside and Imperial counties, California, touching extreme eastern San Diego County; extreme northeastern Baja California; and the Mexican states of Sonora, Chihuahua, Coahuila, Nuevo Léon, Tamaulipas, San Luis Potosí, and the northern tip of Veracruz; also Tiburón Island in the Gulf of California; probably present in northeastern Durango and northern Zacatecas (fig. 67). Has been introduced and seems to have gained a foothold in Vernon County, Wis.

21 a. Intergenials usually absent (fig. 41); prenasals generally in contact with first supralabials (fig. 43); tail rings complete, or broken only on the middorsal line; adults exceed 900 mm. **22**

21 b. A pair of intergenials usually present (fig. 46); generally no contact between the prenasal and first supralabial (fig. 45); dark tail rings often broken laterally; size smaller, adults rarely exceeding 900 mm. A pattern of red, circular, and ill-defined blotches on a pinkish ground color. **Crotalus exsul**

Cedros (Cerros) Island off the Pacific Coast of Baja California (fig. 67).

22 a. General color pink, red, brick-red, or red-brown; usually no light areas present within the diamonds; light preocular stripe 1 or 2 scales wide,* dull and often obscure; supraocular light crossbars usually absent. A pattern of reddish, almost unicolor, diamonds on a pinkish ground color. **Crotalus ruber**
(Fig. 83).

* Preferably to be determined at the second row of scales above the supralabials if the scales are regular.

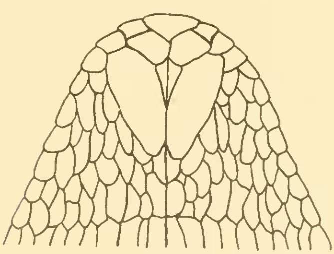

Fig. 46. Chin shields of *Crotalus*; intergenials present.

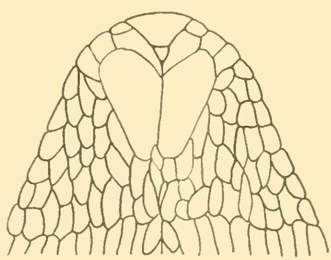

Fig. 47. Chin shields of *Crotalus*; submental present.

The Californias from Lat. 34° to Lat. 26° including southeastern Los Angeles County, Orange County (excluding the coastal plain) Riverside County (west of the desert), San Diego County, and extreme southwestern Imperial County, California; Baja California, Mexico, from the northern border to the vicinity of Comondú, but excluding the deserts of the north lying east of the Sierra Juárez and Sierra San Felipe; also the adjacent Gulf of California islands of Angel de la Guarda, Pond, South San Lorenzo, San Marcos, and Monserrate (fig. 67).

22 b. General color brown, olive-brown, or yellow-brown; light areas usually present within the diamonds; light preocular stripe 3 or more scales wide, bright and conspicuous; supraocular light cross-bars usually in evidence. Dorsal pattern of brown or olive-brown blotches on a buff background. **Crotalus lucasensis** *(Fig. 82).*

The southern part of the peninsula of Baja California, Mexico, from Lat. 25°30′ to the Cape; the adjacent islands of Santa Margarita and San José (fig. 67).

23 a. Two internasals (fig. 48). **29**

23 b. More than two internasals i. e. scales between nasals, and in contact with rostral, regardless of size or position* (fig. 49). **Crotalus viridis** *(For subspecies continue on to 24).*

24 a. Light postocular stripe 1 or 1½ scales wide and clearly outlined (fig. 50); body blotches commonly subrectangular, with even edges and usually with a narrow light border (fig. 52). **25**

* I have already stated (p. 198) that the internasal criterion will occasionally fail properly to key out *viridis* and its subspecies. It may be noted at this point that if the snake is from California west of the Sierra Nevada, from Oregon, Washington, British Columbia, northern Nevada, Idaho, Montana, Alberta, Saskatchewan, Wyoming, Utah (except the extreme southwest), Colorado, the Dakotas, western Nebraska, or western Kansas one may safely take course 24 even though the snake have only 2 internasals.

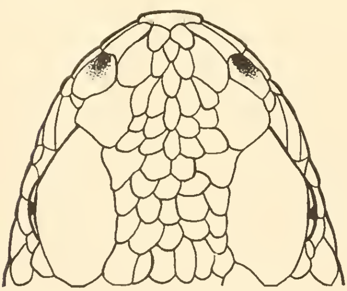

Fig. 48. Crown of *Crotalus* showing two internasals.

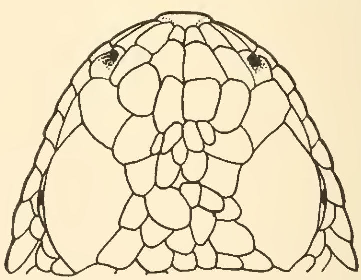

Fig. 49. Crown of *Crotalus* showing four internasals.

24 b. Light postocular stripe 2 or more scales wide, often indefinite or absent (figs. 10 and 51); body blotches, if in evidence, commonly diamonds, ellipses, or if rectangles, with edges rough or serrated, and often without narrow light borders. 26

25 a. Color usually green or olive-green; less often olive-brown or brown; scale-rows 27 or 25; dorsal scale rows at the center of the tail 13 or more; adult size exceeding 850 mm. A pattern of even-edged dark-brown rectangular or subhexagonal blotches usually surrounded by a thin light line. **Crotalus viridis viridis** *(Fig. 85).*

The Great Plains from Long. 97° to the Rocky Mountains and from southern Canada to extreme northern Mexico including the following: southwestern Saskatchewan (south of the South Saskatchewan River and west of Long. 107°30'); southeastern Alberta (south of the Red Deer River and east of Long. 113°); Montana, except the higher mountains in the west; the Lemhi Valley in Idaho; Wyoming east of the Rockies; Colorado (except in the higher mountains, and in the basins of the Colorado and Green rivers west of the Continental Divide); extreme southeastern Utah and northeastern Arizona (San Juan River basin); New Mexico, except the mountains of the west-center; extreme northeastern Sonora and northern Chihuahua near the U. S. boundary; southwestern North Dakota (west of the Missouri River but including the first tier of counties on the eastern bank); western South Dakota (limiting counties Hand and Jerauld); western Nebraska; central and western Kansas (limiting counties Riley and Geary); Oklahoma west of Woods and Custer counties; Texas west of Long. 97° and north of Lat. 30° (fig. 68). The rattler of the western Mississippi basin plains.

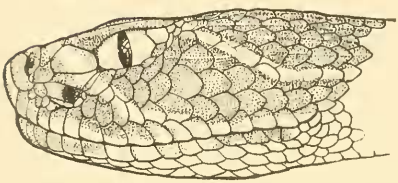

Fig. 50. Lateral head pattern of *C. v. viridis.*

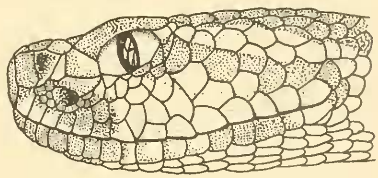

Fig. 51. Lateral head pattern of *C. v. oreganus.*

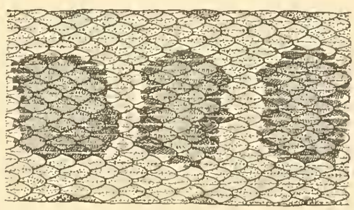

Fig. 52. Dorsal pattern of *C. v. viridis.*

25 b. Color, pink, red, or red-brown;* scale rows 25 or 23; dorsal scales at the center of the tail 12 or less; adult size rarely exceeding 650 mm. **Crotalus viridis nuntius** *(Fig. 86).*

Northeastern and north-central Arizona from the New Mexican line to Cateract Creek including the following: the basin of the Little Colorado River; the southern part of the Apache Indian Reservation; the Hopi Indian Reservation; and the Coconino Plateau, from the south brink of the Grand Canyon south to U. S. Highway 66 (fig. 68).

26 a. Color darker, not straw, cream, or yellow; adult size larger, over 650 mm. **27**

26 b. Color straw, cream, or yellow; blotches often only faintly in evidence or obsolete in adults; adult size smaller, usually under 650 mm. **Crotalus viridis concolor** *(Fig. 89).*

The basins of the Colorado and Green rivers including: a small area in southwestern Wyoming; Utah east of Long. 111° and north of the San Juan River (intergradation with *viridis viridis* is indicated in this river valley); western Mesa, southwestern Delta, and northern Montrose counties in western Colorado (fig. 68).

27 a. Adult color other than vermilion or salmon; body blotches in evidence, or body black. **28**

27 b. Adult color vermilion or salmon; body blotches tending toward obsolescence in adults. **Crotalus viridis abyssus** *(Fig. 87).*

The Grand Canyon of the Colorado River, Grand Canyon National Park, Arizona from the north to the south rim (fig. 68).

28 a. Ground color lighter, usually buff or drab; body blotches occupy less or but little more longitudinal space than interspaces; secondary series of lateral blotches little in evidence; a pattern of dark-brown dorsal blotches (often with light centers) on a buff or drab ground color. **Crotalus viridis lutosus** *(Fig. 88).*

The Great Basin between the Rocky Mountains and the Sierra Nevada including: Idaho south of Lat. 44°; Utah west of Long. 111°; Arizona north and west of the Colorado River and the north rim of the Grand Canyon; all of Nevada except Esmeralda, southern Nye, and Clark counties; California, east of the Sierra Nevada, from Lower Klamath Lake south to below Mono Lake; Oregon south and east of the line Upper Klamath Lake—Fort Rock—Burns—Council (Idaho), this being the approximate line of intergradation with *C.v. oreganus* (fig. 68).

28 b. Ground color darker, usually dark-gray, olive, brown, or black; dark-brown or black dorsal blotches (usually diamonds or hexagons) occupying considerably more longitudinal space than the

---

* Specimens from the plateau south of the Grand Canyon, Arizona, are usually greenish or grayish, but should be referred to this subspecies.

interspaces; a secondary series of lateral blotches conspicuously in evidence. Some mountain specimens nearly uniform black, only patches of yellow scales representing the interspaces on the mid-dorsal line. **Crotalus viridis oreganus** *(Figs. 90, 109, and 110).*

The Pacific slope from British Columbia to central Lower California including the following: the basins of the Fraser and Okanogan Rivers in south-central British Columbia, south of Lat. 51° and between Long. 119° and 122°, Washington east of the Cascade Mountains; the western edge of Idaho from Coeur d'Alene south to Lat. 44°; Oregon west of the line Upper Klamath Lake—Fort Rock—Burns—Council (this being the approximate line of intergradation with *lutosus*) but absent from northwestern Oregon west of the Cascades and from southwestern Oregon immediately contiguous to the coast;* all of California west of the Sierra Nevada (including these mountains), but excluding a narrow coastal fringe in the extreme northwest and the entire desert (transmontane) area of the southeast; the west coast and mountains of Baja California from the U. S. border south to Punta María (Lat. 29°); the mountain areas of central and southern Arizona south of the line Peach Springs—San Francisco Peak—Springerville but not including the desert areas of the southwest; the mountains of extreme west-central New Mexico (vicinity of Steeple Rock) and of extreme northern Sonora;† the Pacific Coast islands—Morro Rock, Santa Catalina, and Los Coronados (fig. 68).

29 a. No vertical light line on the posterior edge of the prenasals and first supralabials. **30**

29 b. A vertical light line on the posterior edge of the prenasals and first supralabials (fig. 53). A pattern of black, or dark-brown diamonds, with lighter centers, surrounded by single rows of yellow scales on a dark-brown background. **Crotalus adamanteus** *(Fig. 79).*

The coastal plains of the following southeastern and gulf states: North Carolina south of Albemarle Sound; South Carolina; Georgia; all

* An occasional specimen is found at the river mouths, evidently carried down by floodwater.

† The Arizona—Sonora range of *oreganus* does not conjoin the coastal range; there is an unoccupied desert gap between. Nevertheless I do not find consistent differences warranting the recognition of the Arizona form as a separate subspecies, *C. v. cerberus*.

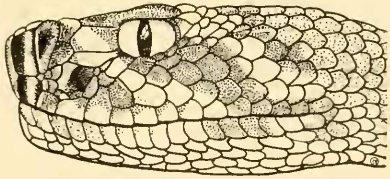

Fig. 53. *C. adamanteus,* showing vertical light marks on prenasal and first supralabial.

of Florida, with many of the adjacent keys; Alabama; Mississippi; and extreme southeastern Louisiana (fig. 67). A lowland species.

30 a. Supraoculars not pitted, sutured, nor with broken outer edges (fig. 14). **31**

30 b. Supraoculars pitted, sutured, or with outer edges broken (fig. 54). A pattern of buff, gray, brown, or deep red-brown blotches on a background of straw, tan, buff, brown, or gray; often with gray suffusions on the sides of head and body, and with black-tipped scales scattered on the dorsum particularly at blotch edges.
Crotalus mitchellii stephensi
(Fig. 93).

The mountain and rocky desert areas of east-central California and southwestern Nevada including: the eastern slopes of the Sierra Nevada from southern Mono County to southern Kern County and eastward in California through the desert mountain ranges to the Nevada line; Nevada west and south of the line Hawthorne—Tonopah—St. Thomas. Intergradation with *C.m. pyrrhus* occurs approximately along the line Barstow—Ivanpah, which thus constitutes the southern limit of *stephensi* (fig. 69). A rock inhabiting form.

31 a. No distinct and evenly-outlined light supraocular crossbars curving forward inwardly; scales on the crown and frontal area smooth and flat. **32**

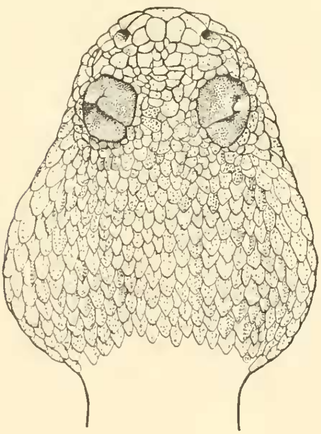

Fig. 54. *C. m. stephensi,* showing sutured supraoculars.

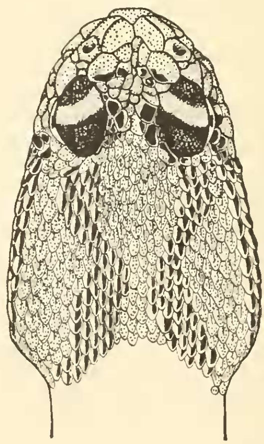

Fig. 55. Dorsal head pattern, *C. enyo,* showing light marks on supraoculars curving forward inwardly.

31 b. Distinct and evenly-outlined light supraocular crossbars curving forward inwardly (fig. 55); scales on the crown and frontal area rough, ridged, or knobby; outer edges of the supraoculars raised above the crown (particularly evident in life) forming a depression in the frontal area; dorsal scales sharply keeled and with prominent posterior bosses; ridged spinous process sharply evident. A pattern of dark-brown blotches on a fawn background, usually with black in the lateral corners of the blotches at midbody.
Crotalus enyo
(Fig. 77).

The peninsula of Baja California, Mexico, from the Cape north to Lat. 30°, together with the adjacent islands of San Francisco, Carmen, and Partida, in the Gulf of California, and Santa Margarita on the Pacific side (fig. 66).

32 a. General color dark and with conspicuous blotches 33

32 b. General color white, cream, or yellow, with grayish tail; a middorsal light line faintly in evidence, especially at the neck; paired apical scale-pits rendered conspicuous (particularly near the tail) by gray dots. **Crotalus unicolor***

Aruba Island, Dutch West Indies, off the coast of Venezuela (fig. 65).

33 a. Head larger; head length contained less than 25 times in adult body length; proximal rattle width contained in head length more than 2½ times. 34

33 b. Head notably small for a rattlesnake; head length in adults contained in body length (over-all) 25 times, or more; proximal rattle width contained in head length less than 2½ times; pattern

* Not to be confused with albino specimens of other species (fig. 111).

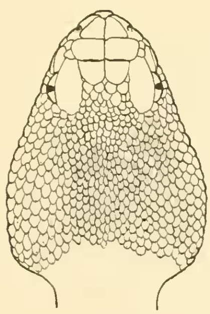

Fig. 56. *C. molossus,* showing enlarged scales in anterior part of frontal area.

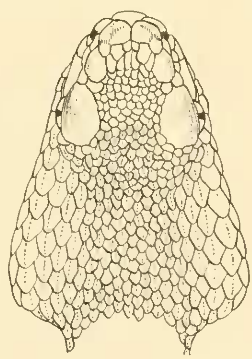

Fig. 57. *C. horridus,* showing lack of enlarged scales in frontal area.

a series of cross-rings or blotches comprising brown punctations on a pink, buff, or gray ground. **Crotalus tigris** *(Fig. 94).*

The rocky desert foothills of south-central Arizona, and northeastern and central Sonora, from the vicinity of Phoenix, Arizona, via Tucson, to Guaymas, Sonora, Mexico, including the following Arizona mountain ranges: Phoenix, Salt River, Estrella, Santa Catalina, Tucson, Coyote, Baboquivari (Verde), Sierrita, and Santa Rita (fig. 69). A rock inhabiting form.

34 a. Usually a definite division between the scales in the frontal and the prefrontal areas; scales in the anterior part of frontal area larger than those behind (fig. 56); anterior body pattern not in chevron-shaped bands or not all black. 36

34 b. No definite division or continuous suture between the scales in the frontal and the prefrontal areas; scales in the anterior part of frontal area not conspicuously larger than those behind (fig. 57); normal pattern a series of chevron-shaped crossbands sometimes broken (fig. 58), or with the body all black. **Crotalus horridus** *(For subspecies continue on to 35).*

35 a. Dorsal scale rows usually 23; postocular dark stripe indistinct; no middorsal reddish-brown stripe evident anteriorly; sometimes entirely black. **Crotalus horridus horridus** *(Fig. 96).*

The northeastern and north-central United States including: all of the Atlantic states from southwestern Maine to southern Virginia, (possibly exterminated in Delaware); West Virginia; Ohio; central and eastern Kentucky; the mountains of western North Carolina, northwestern South Carolina, northern Georgia, central and eastern Tennessee, and extreme northern Alabama; Indiana; Illinois (except the southern tip); southwestern Wisconsin; extreme southeastern Minnesota; eastern and southern Iowa; Missouri (except the southeast corner); extreme southeastern Nebraska; Kansas (east of Long. 97°);

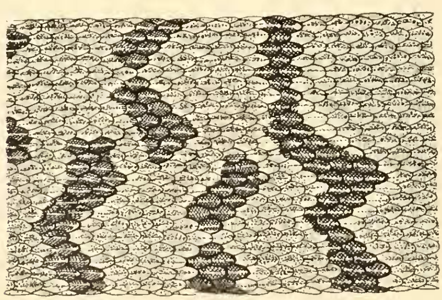

Fig. 58. Dorsal pattern of *C. h. horridus.*

the mountainous area of northwestern Arkansas; the eastern half of Oklahoma; north-central Texas (fig. 68). Originally present in southwestern Ontario but now said to be extinct.*

35 b. Dorsal scale rows usually 25; postocular dark stripe distinct and in contrast with the ground color; a middorsal reddish-brown or brown stripe evident anteriorly. **Crotalus horridus atricaudatus** *(Fig. 97).*

The lowlands of the South Atlantic and Gulf states and the lower Mississippi Valley including: eastern North Carolina; South Carolina; central and southern Georgia; Florida north of Lat. 29°30′; central and southern Alabama; Mississippi; extreme western Kentucky and Tennessee; Louisiana; southern and eastern Arkansas; extreme southeastern Missouri and southern Illinois; and Texas east of Long. 99° and north of Lat. 28° (fig. 68). On the Atlantic Coast this subspecies may range as far north as southern New Jersey.*

36 a. Dorsal scale rows usually less than 24; scale rows at the center of the tail 11 or less; ventrals rarely exceed 168; 1 or 2 scales between bottom-center of orbit and supralabials; usually a single loreal, longer than high (fig. 59); size small, adults rarely exceed 600 mm. **Crotalus triseriatus** *(For subspecies continue on to 37).*

36 b. Dorsal scale rows usually exceed 24; scale rows at the center of the tail 12 or more; ventrals rarely less than 169; 3 or more scales between bottom-center of orbit and supralabials; usually more than one loreal, but if single, then higher than long (fig. 60); size large, adults over 600 mm. 38

37 a. Dorsal pattern a single series of dark-brown blotches, often edged with black and not sharply contrasting with the ground-color of

* This rattlesnake, once indigenous to what are now the most populous areas of the United States, has largely been forced out of industrial and agricultural districts, but still remains in adjacent mountains and forests, where rocky or wooded retreats are available. Thus, its present range is intermittent and it is extinct in many areas over which it once ranged.

The boundaries between the subspecies *C.h. horridus* and *C.h. atricaudatus* are as yet not definitely determined. The division of the species *C. horridus* into these two subspecies considerably complicates the statement of the range so that it is difficult to visualize. For the species *C. horridus* as a whole the range can be more succinctly given thus: All of the states east of the Mississippi River except Michigan; also with a limited range in five other states, being confined to southwestern Maine, southern New Hampshire and Vermont, southern and western Wisconsin, and Florida north of Lat. 29°30′; it is possibly extinct in Delaware. West of the Mississippi the range includes: extreme southeastern Minnesota; eastern and southern Iowa; probably extreme southeastern Nebraska; Missouri; Kansas, east of Long. 97°; the eastern half of Oklahoma; Arkansas; Louisiana; and Texas east of Long. 99° and north of Lat. 28° (fig. 68). Of course to all of these areas the previous remarks concerning possible extermination in industrial and agricultural territories apply.

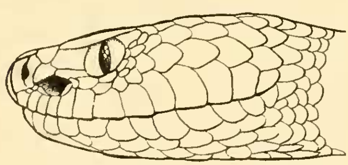

Fig. 59. Lateral head scales of *C. t. triseriatus.*

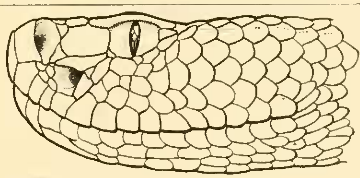

Fig. 60. Lateral head scales of *C. basiliscus.*

brown or dark-gray (fig. 61); usually 3 labials in contact with pit-border. **Crotalus triseriatus triseriatus** *(Fig. 100).*

The central Mexican plateau including: the higher areas in extreme southern Durango, Nayarit, southern Zacatecas, San Luis Potosí, southwestern Tamaulipas, Jalisco, Aguascalientes, Guanajuato, Querétaro, Hidalgo, Michoacán, México (state), Distrito Federal, Morelos, Guerrero, Tlaxcala, northern Puebla, and west-central Veracruz (fig. 71). Intergrades with *C.t. pricei* in southern Durango.

37 b. Dorsal pattern of two parallel rows of small brown blotches on a steel-gray ground color (fig. 62); usually 2 labials in contact with the pit-border. **Crotalus triseriatus pricei** *(Fig. 101).*

The mountains of southeastern Arizona and northwestern Mexico including: the Pinalino (Graham), Santa Catalina, Santa Rita, Huachuca, and Chiricahua mountains in Arizona; and the Sierra Tarahumare and Sierra Madre in eastern Sonora, western Chihuahua, and western Durango, intergrading with *C.t. triseriatus* in the southern part of the last named state (fig. 71).

38 a. Usually a single loreal; tail rings sharply contrasting in color. **Crotalus scutulatus** *(See under 18b).**

38 b. Usually two or more loreals; tail unicolor or with rings rather faint—not sharply contrasting. **39**

39 a. Tail often black, or with rings faintly in evidence against a dark background; vertebral process not conspicuous; tail shorter, approximately 7.1 per cent of body length (over-all) in the males and 5.8 per cent in females; subcaudals rarely more than 27 in males, or 23 in females; initial rattle-button (if present), over 5 mm. wide; body color primarily olive-green, or yellow-green with dark-brown blotches, often with a light interior blotch on each side of the center; blotch-bordering scales unicolor. **Crotalus molossus** *(For subspecies continue on to 40).*

* This is the only species which is double-keyed, for *scutulatus* may or may not have a *cinereous*-like tail, and hence may take either course 17a or 17b.

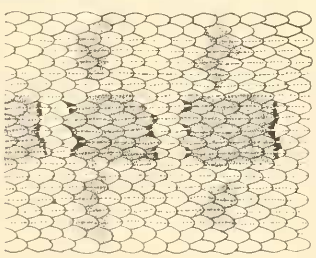

Fig. 61. Dorsal pattern of *C. t. triseriatus.*

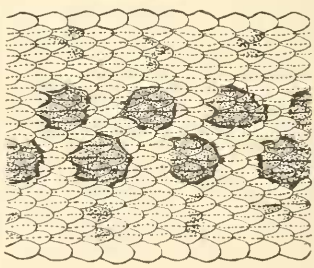

Fig. 62. Dorsal pattern of *C. t. pricei.*

39 b. Tail not black but with gray rings on a darker gray background; vertebral process prominent; tail longer, approximately 9.2 per cent of body length in the males and 7.4 per cent in the females; subcaudals in males rarely less than 28, or 23 in females; initial rattle-button (if present) less than 5 mm. wide; body pattern a series of red or red-brown diamonds (outlined with buff) on a pinkish background. **Crotalus basiliscus** *(Fig. 76).*

The west coast of Mexico between Lat. 17° and 25° including southern Sinaloa, Jalisco, Colima, and central Oaxaca certainly, and probably Nayarit, Michoacán, and Guerrero; restricted to the coast and adjacent higher areas (fig. 66).

40 a. Dark dorsal blotches (on the anterior half of the body) open on the sides and extending to the ventrals (fig. 63). A pattern of dark-brown blotches (often with a light interior blotch on each side of the center) on an olive-green or yellow-green ground color; blotch bordering scales unicolor. **Crotalus molossus molossus** *(Fig. 78).*

From west Texas to Arizona and south in Mexico to northern Durango, including: the limestone area north and west of San Antonio, and trans-Pecos Texas; New Mexico southwest of the line Gallup—Otto—Carlsbad; Arizona, from the Grand Canyon and Little Colorado River south, but not including Mohave and Yuma counties; central and eastern Sonora, and western Chihuahua, intergrading with *C.m. nigrescens* in northern Durango; also San Esteban Island in the Gulf of California (fig. 70).

40 b. Dark dorsal blotches (on the anterior half of the body) closed laterally by light borders (fig. 64). Body color primarily olive-brown, or brownish-black, with dark-brown diamonds bounded by grayish or yellowish unicolored rows of light scales. **Crotalus molossus nigrescens**

The tableland of Mexico from northern Durango (where it intergrades with *C.m. molossus*) south and east through Durango, southern Coahuila, Zacatecas, western San Luis Potosí, Aguascalientes, eastern Jalisco, Guanajuato, northern Michoacán, México (state), and Distrito Federal, to central Veracruz and southeastern Puebla (fig. 70).

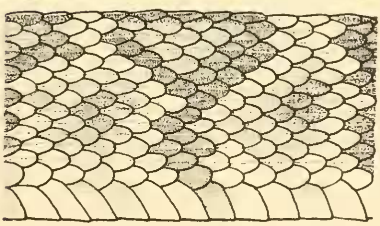

Fig. 63. Lateral pattern of *C. m. molossus.*

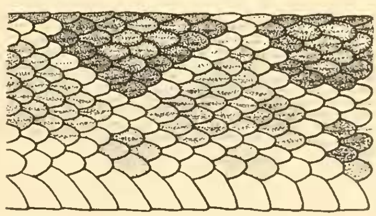

Fig. 64. Lateral pattern of *C. m. nigrescens.*

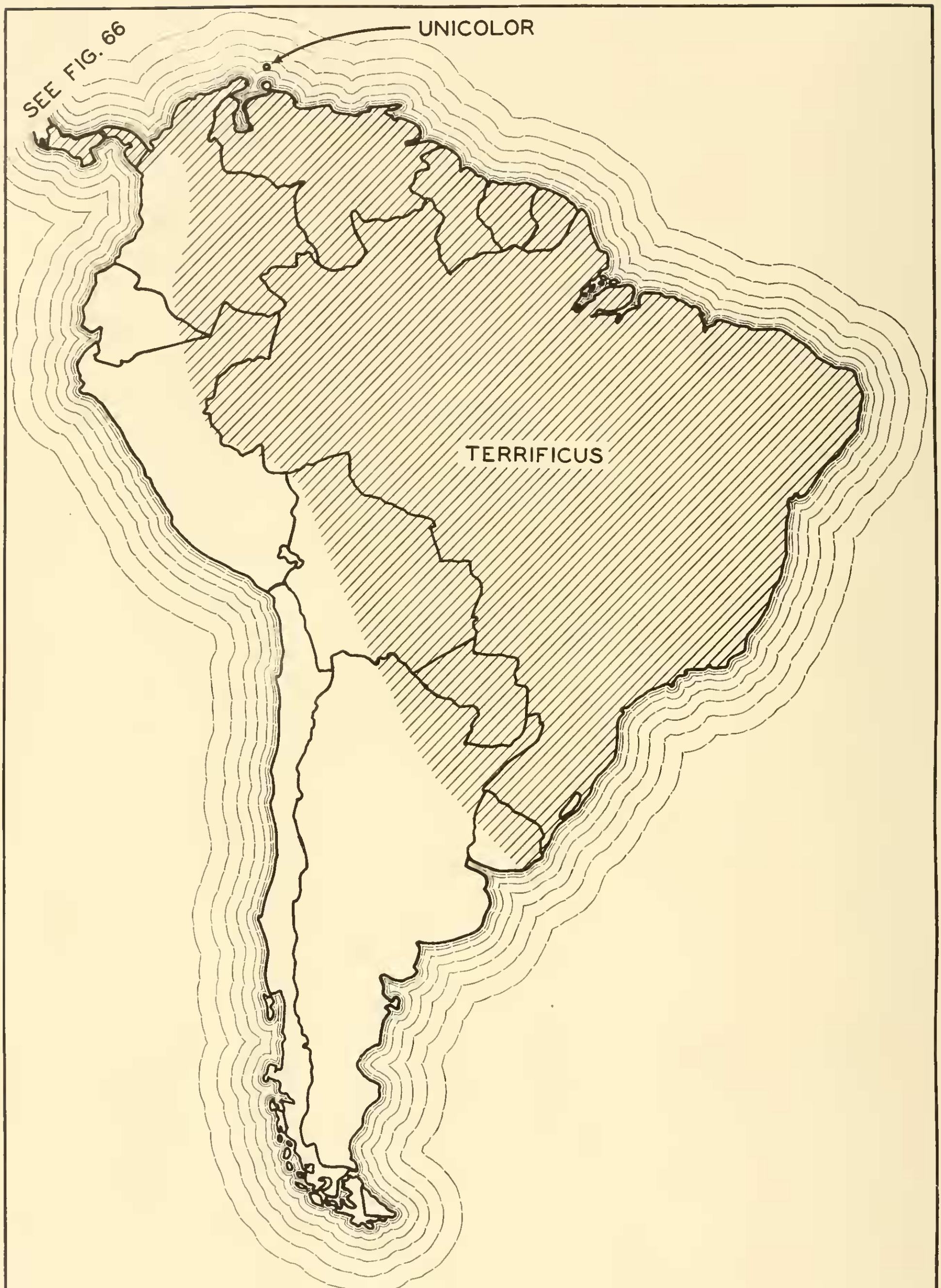

Fig. 65. Ranges of *Crotalus durissus terrificus* (in part) and *Crotalus unicolor*.

(The range of the South American rattlesnake is not known with accuracy, and this map is to be considered only a generalized indication of the area covered. Its presence in the central basin of the Amazon is doubtful).

Note. The grouping of the forms in the several maps is not necessarily an indication of relationship, the arrangement being primarily selected to reduce the required number of maps. However, subspecies of a single species always appear on the same map so that the approximate lines of intergradation can be seen, such lines being indicated by stars.

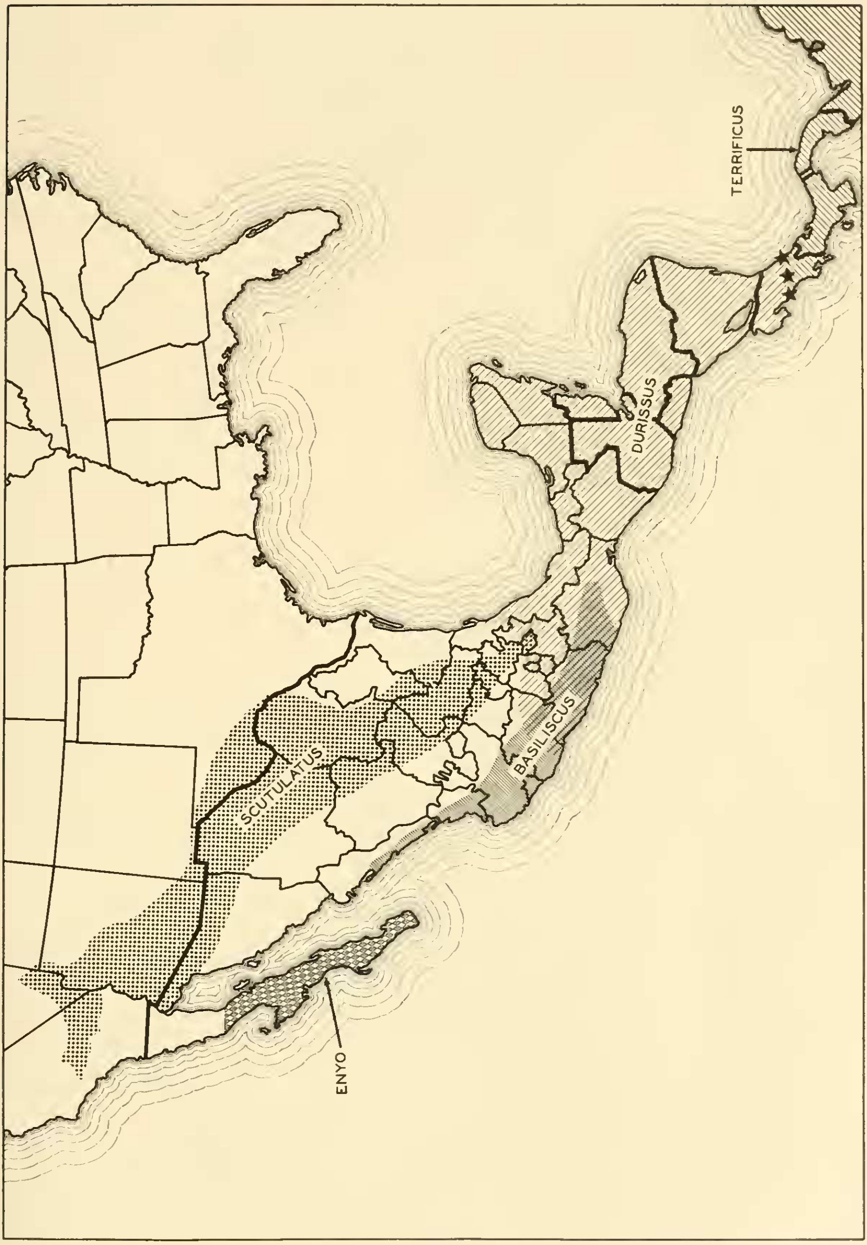

Fig. 66. Ranges of *Crotalus durissus durissus*, *C. d. terrificus*, *Crotalus basiliscus*, *Crotalus enyo*, and *Crotalus scutulatus*.

Although *C.d. terrificus* is indicated as ranging across Panama and the Canal Zone, its presence there is to be regarded as doubtful. For the South American range of this subspecies see fig. 65.

(Stars indicate approximate lines of intergradation between subspecies).

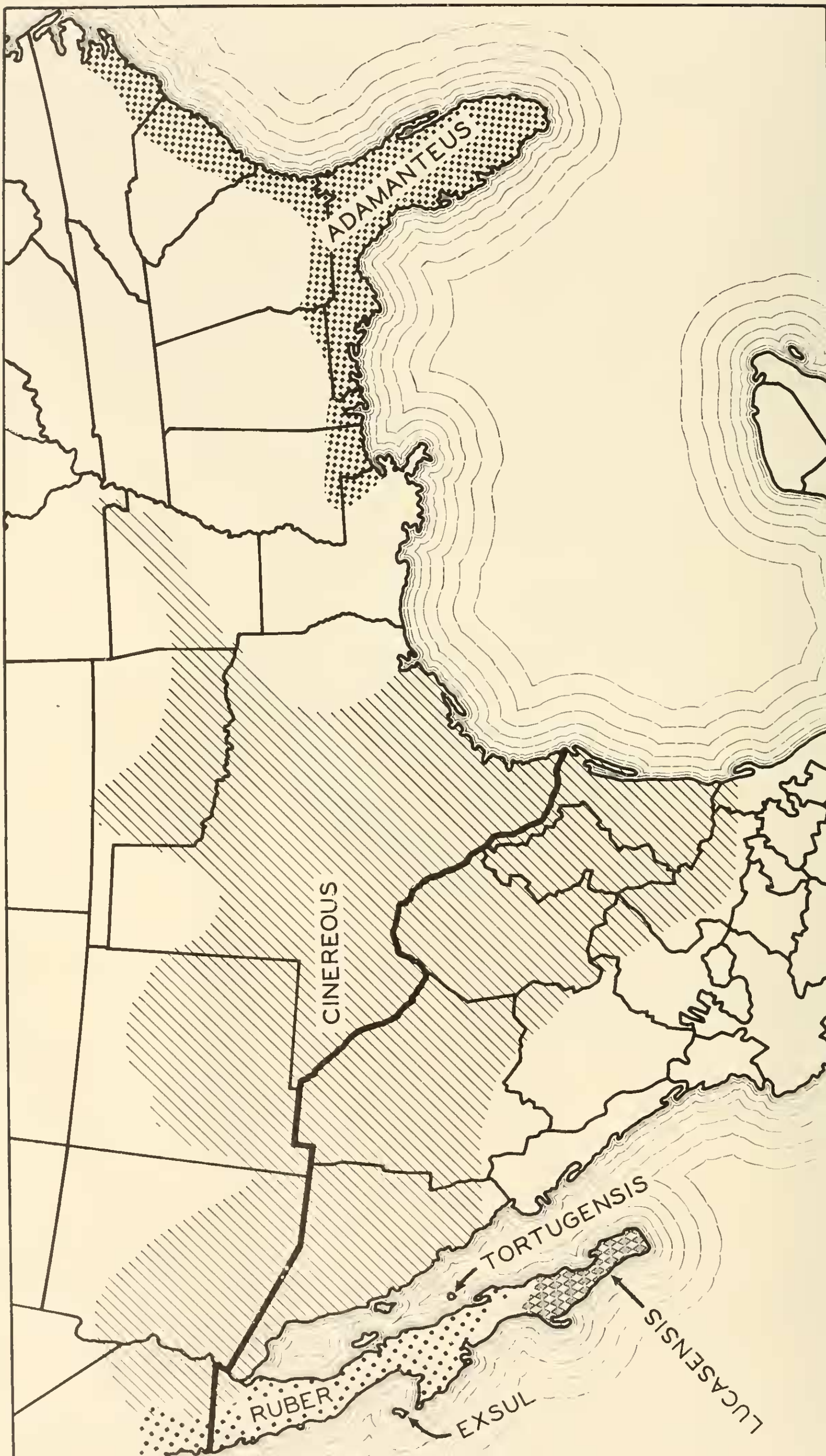

Fig. 67. Ranges of *Crotalus adamanteus*, *Crotalus cinereous*, *Crotalus tortugensis*, *Crotalus lucasensis*, *Crotalus ruber*, and *Crotalus exsul*.

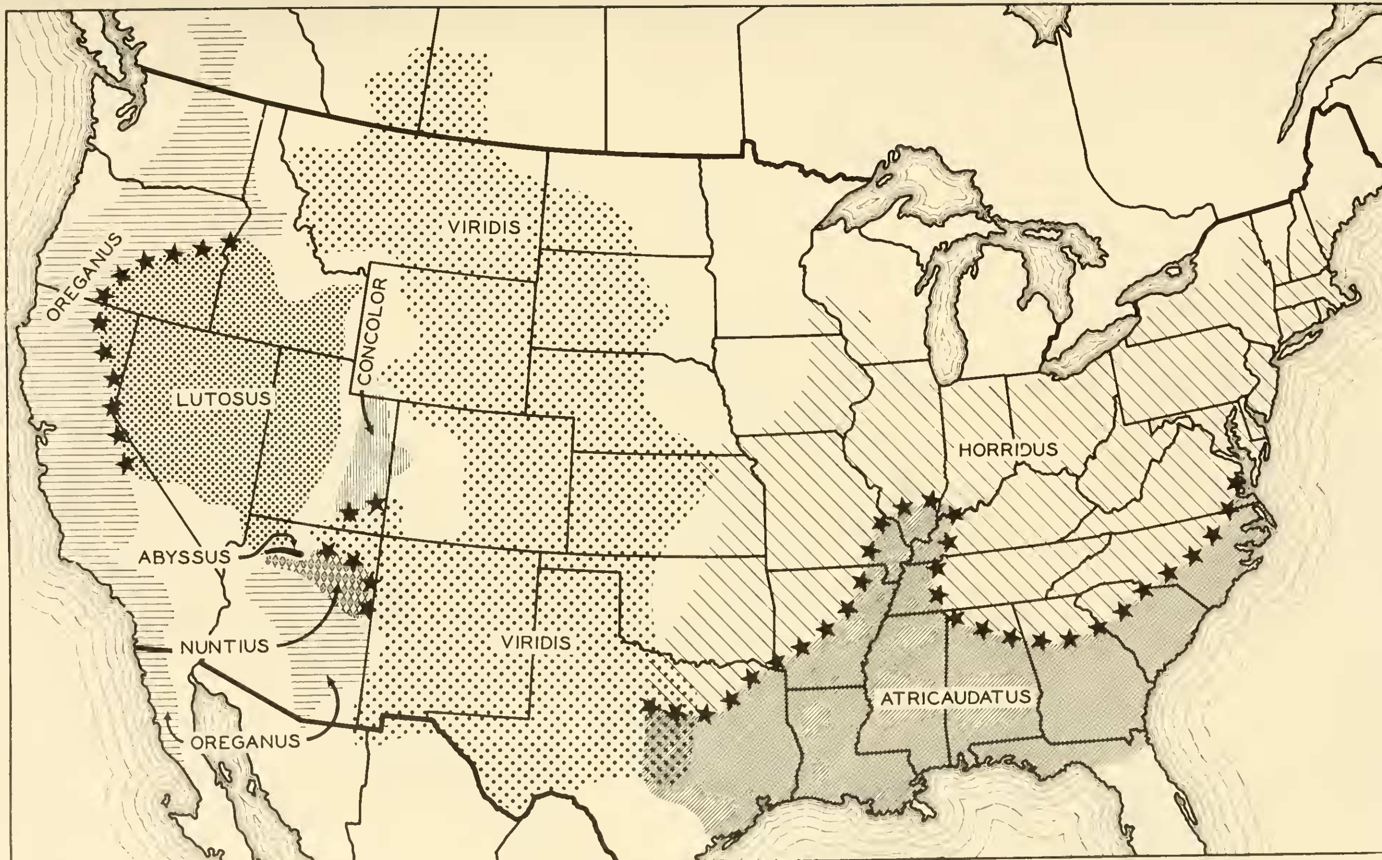

Fig. 68. Ranges of *Crotalus horridus horridus*, *C. h. atricaudatus*, *Crotalus viridis viridis*, *C. v. nuntius*, *C. v. abyssus*, *C. v. lutosus*, *C. v. concolor*, and *C. v. oreganus*.

C. v. abyssus intergrades with *C. v. nuntius* along the south rim of the Grand Canyon, and probably with *C. v. lutosus* along Kanab Creek. The small scale of the map prevents showing this by means of the usual stars, such as are used elsewhere to indicate areas of intergradation.

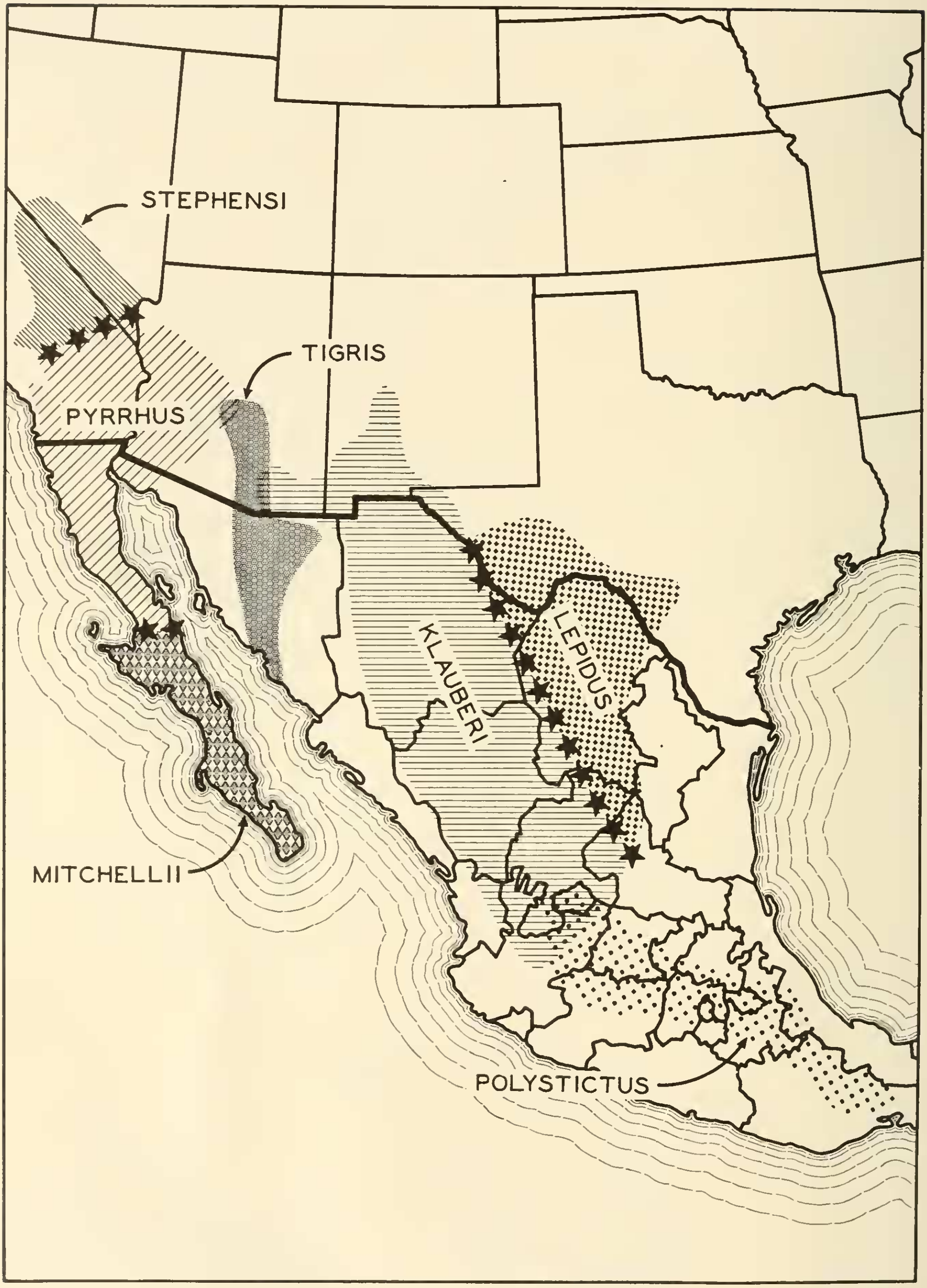

Fig. 69. Ranges of *Crotalus mitchellii mitchellii*, *C. m. pyrrhus*, *C. m. stephensi*, *Crotalus tigris*, *Crotalus lepidus lepidus*, *C. l. klauberi*, and *Crotalus polystictus*.

(Stars indicate approximate lines of intergradation between subspecies).

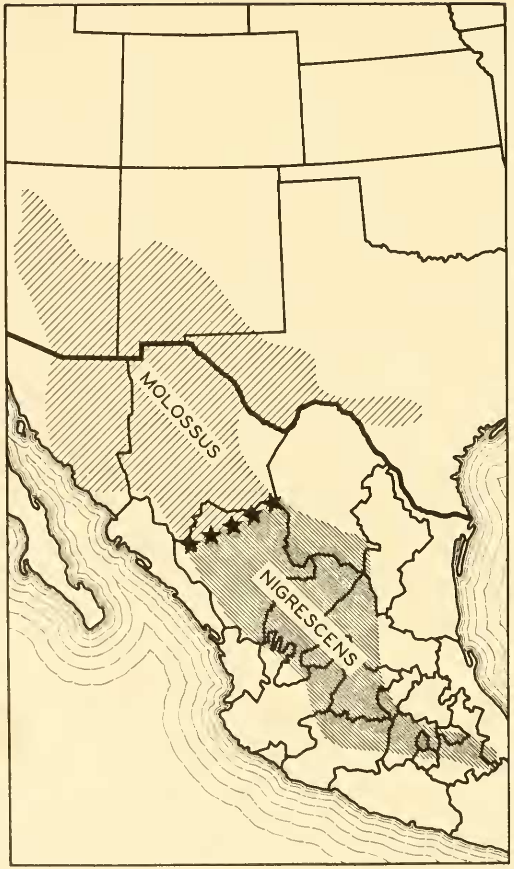

Fig. 70. Ranges of *Crotalus molossus molossus* and *C. m. nigrescens.*

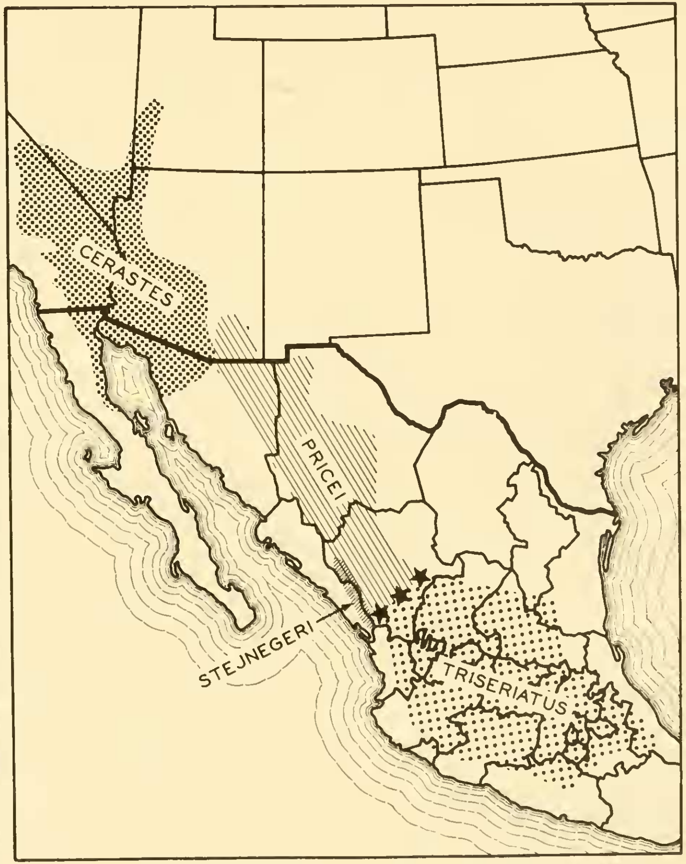

Fig. 71. Ranges of *Crotalus cerastes. Crotalus triseriatus triseriatus. C. t. pricei.* and *Crotalus stejnegeri.*

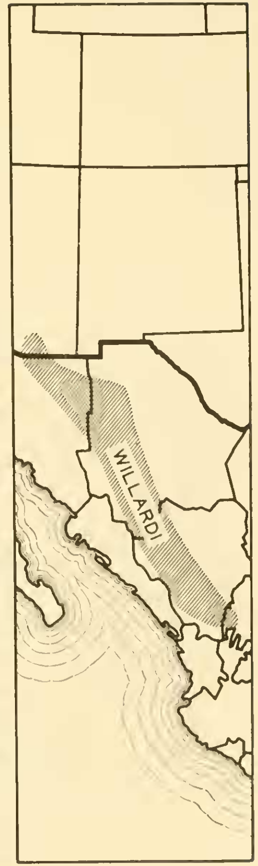

Fig. 72. Range of *Crotalus willardi.*

(Stars indicate approximate lines of intergradation between subspecies).

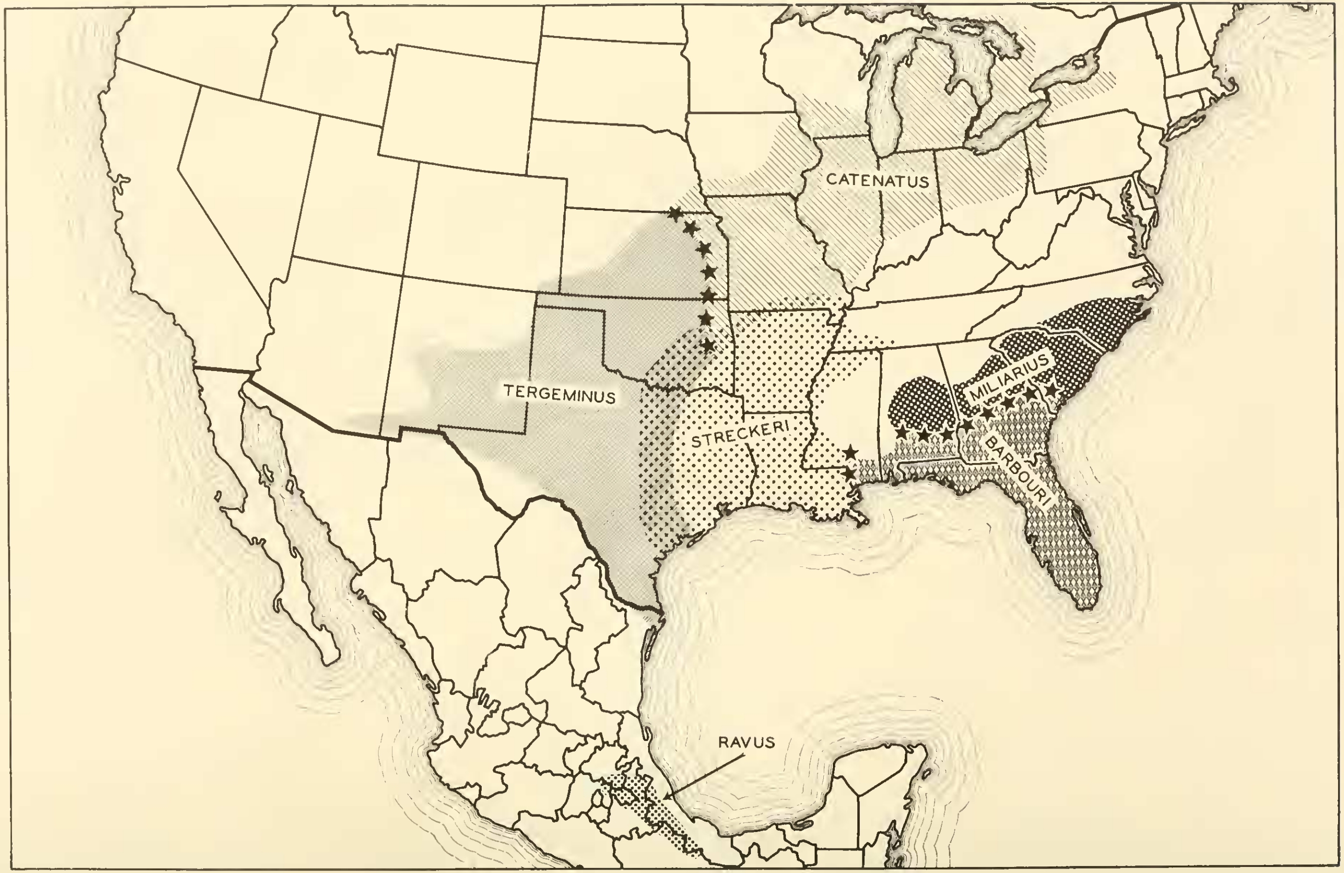

Fig. 73. Range of the genus *Sistrurus* comprising *Sistrurus ravus*, *Sistrurus miliarius miliarius*, *S. m. barbouri*, *S. m. streckeri*, *Sistrurus catenatus catenatus*, and *S. c. tergeminus*.

(Stars indicate approximate lines of intergradation between subspecies).

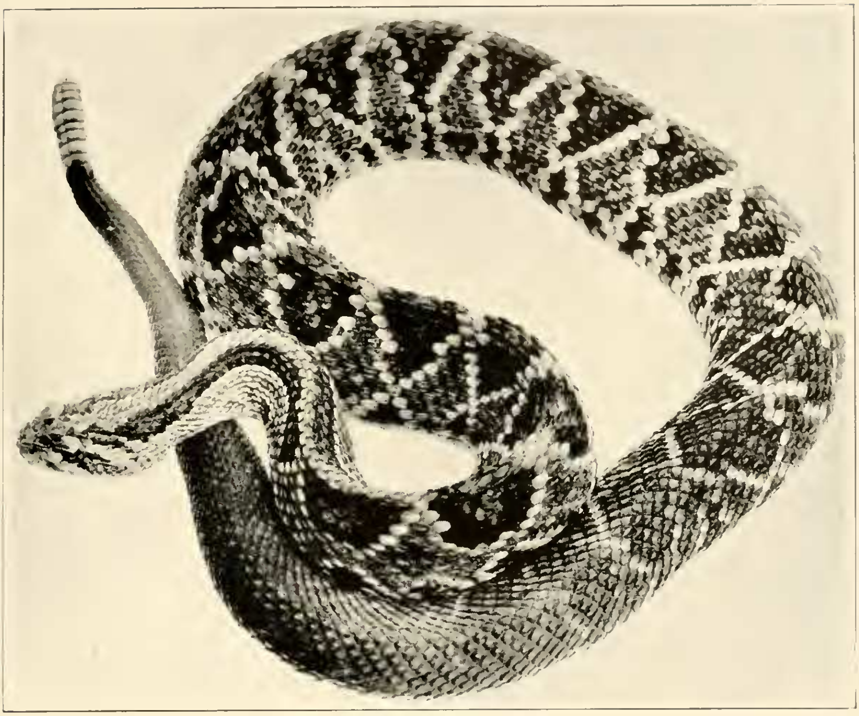

Fig. 74. *Crotalus durissus durissus.*
Central American Rattlesnake (12b).*
(Specimen from Vera Cruz, Mexico. West-coast specimens have less color in the lateral areas between dorsal blotches).

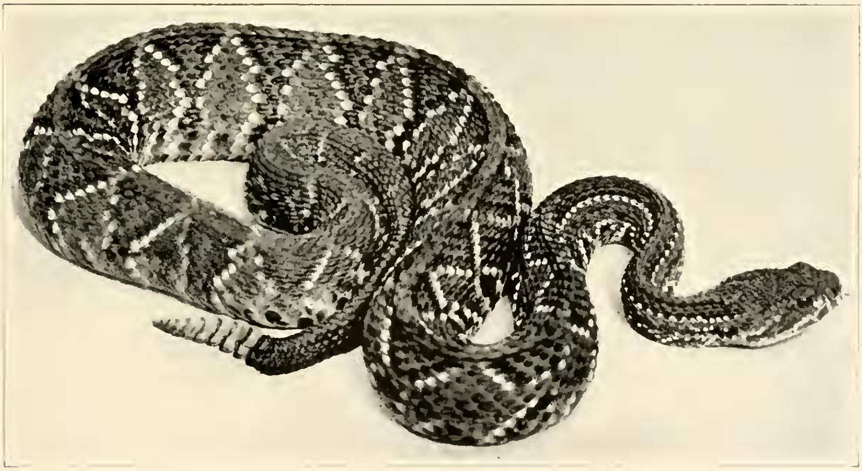

Fig. 75. *Crotalus durissus terrificus.*
South American Rattlesnake (12a).
(Specimen from Central Brazil. Photo by courtesy of the New York Zoological Society).

* This number refers to the item (not page) number in the text of the key, under which the key characters, color description, and range will be found.

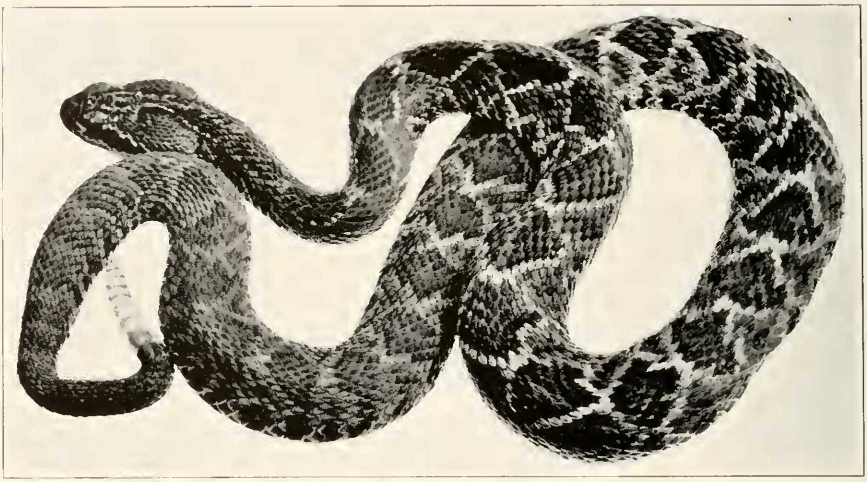

Fig. 76. *Crotalus basiliscus.*
Mexican West-Coast Rattlesnake (39b).
(Specimen from Retes, Sinaloa, Mexico).

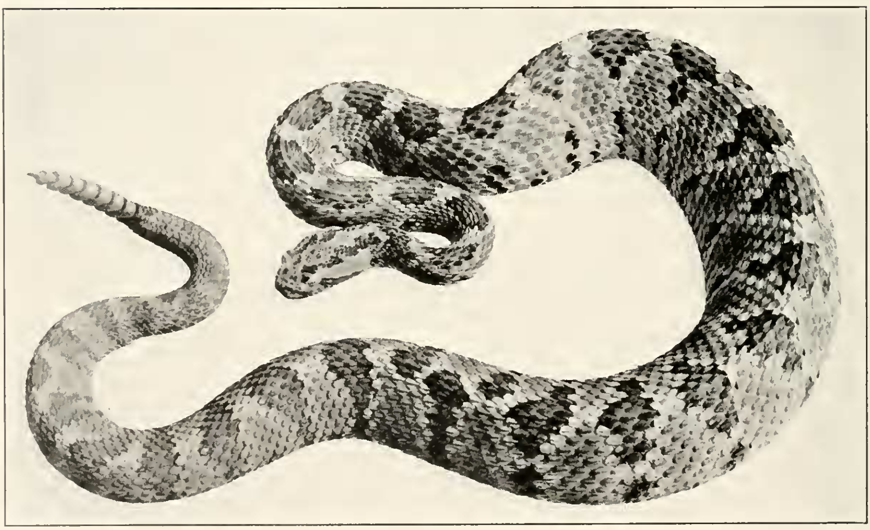

Fig. 77. *Crotalus enyo.*
Lower California Rattlesnake (31b).
(Specimen from La Rivera, Baja California, Mexico).

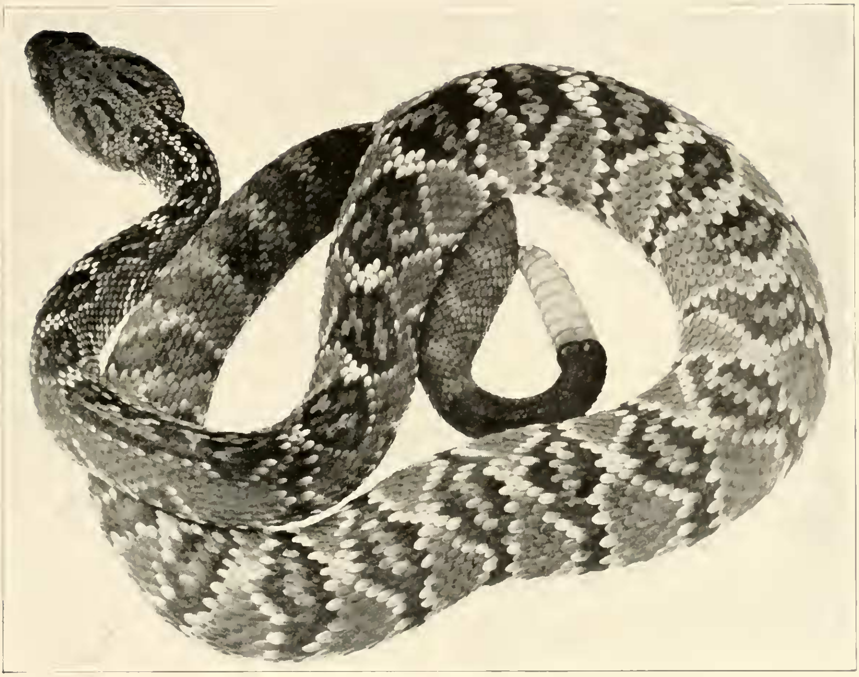

Fig. 78. *Crotalus molossus molossus.*
Northern Black-tailed Rattlesnake (40a).
(Specimen from Entro, Yavapai County, Arizona).

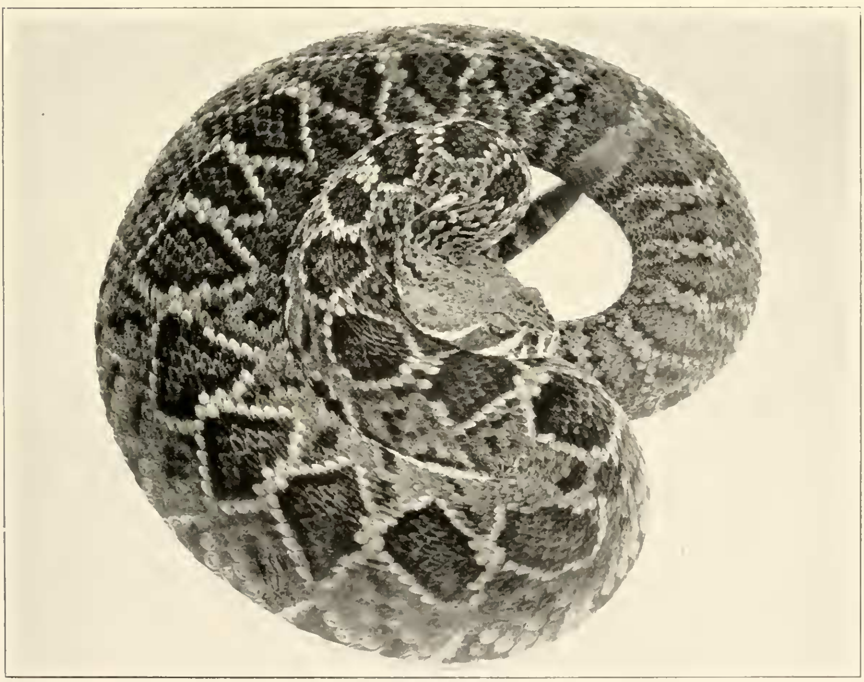

Fig. 79. *Crotalus adamanteus.*
Eastern Diamond Rattlesnake (29b).
(Specimen from Eureka, Marion County, Florida. The blur at the tail is the vibrating rattle).

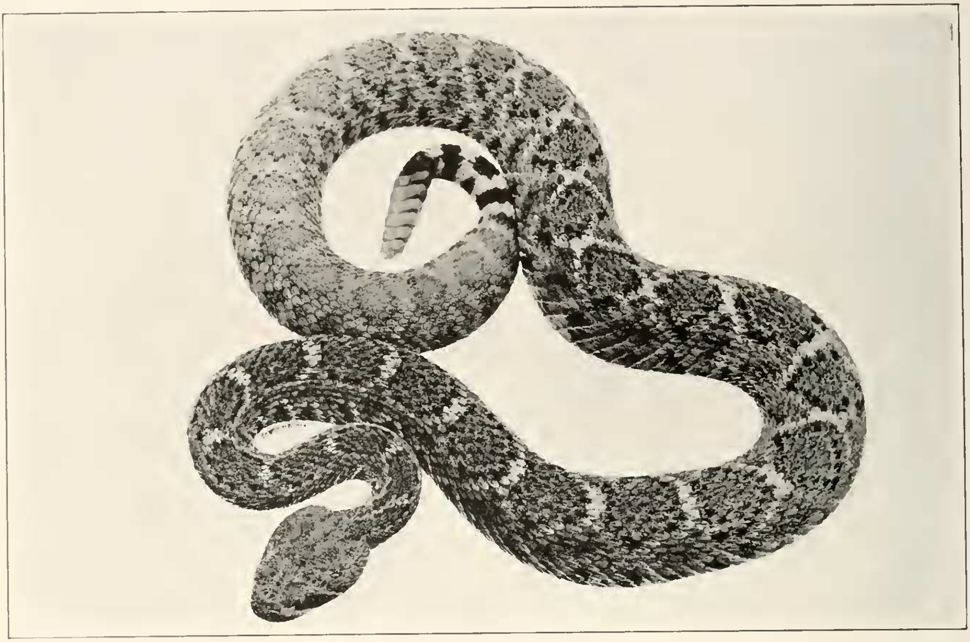

Fig. 80. *Crotalus cinereous.*
Western Diamond Rattlesnake (20b).
(Specimen from Date, Yavapai County, Arizona).

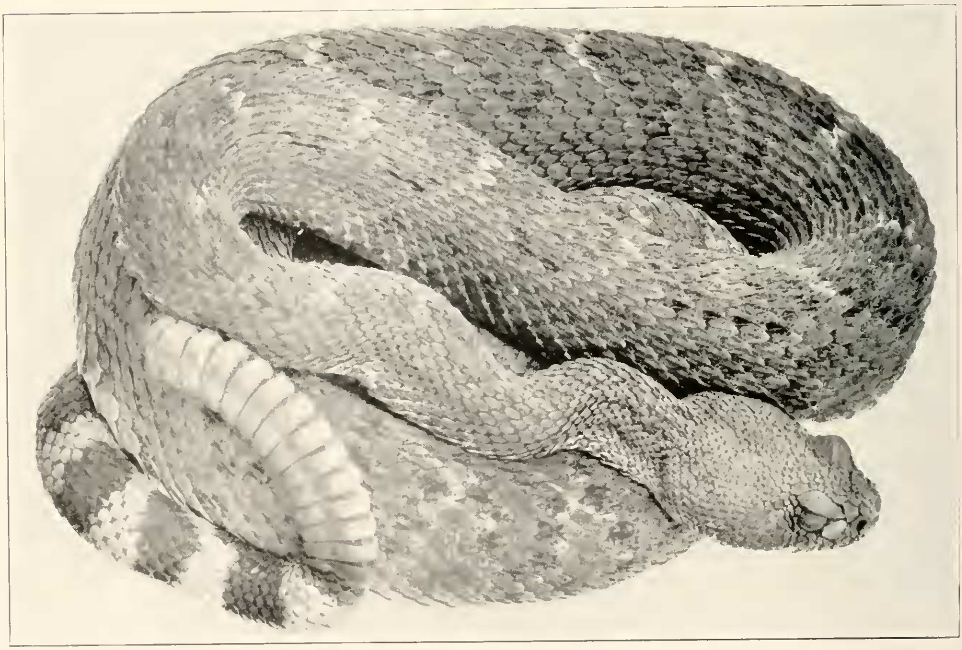

Fig. 81. *Crotalus tortugensis.*
Tortuga Island Diamond Rattlesnake (20a).
(Specimen from Tortuga Island, Gulf of California).

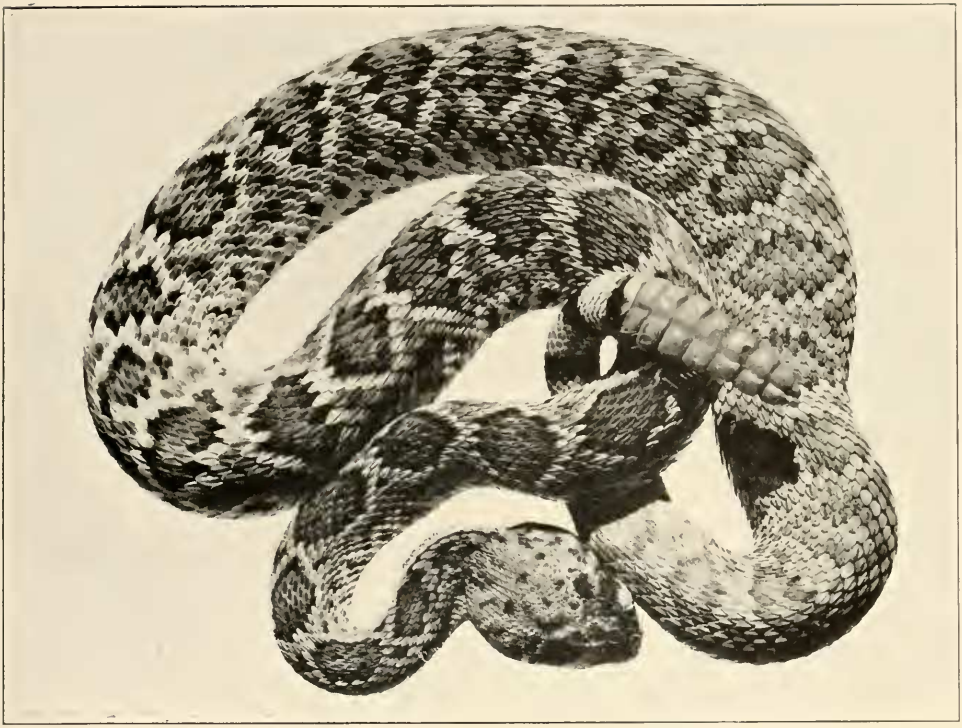

Fig. 82. *Crotalus lucasensis.*
San Lucan Diamond Rattlesnake (22b).
(Specimen from La Rivera, Baja California, Mexico).

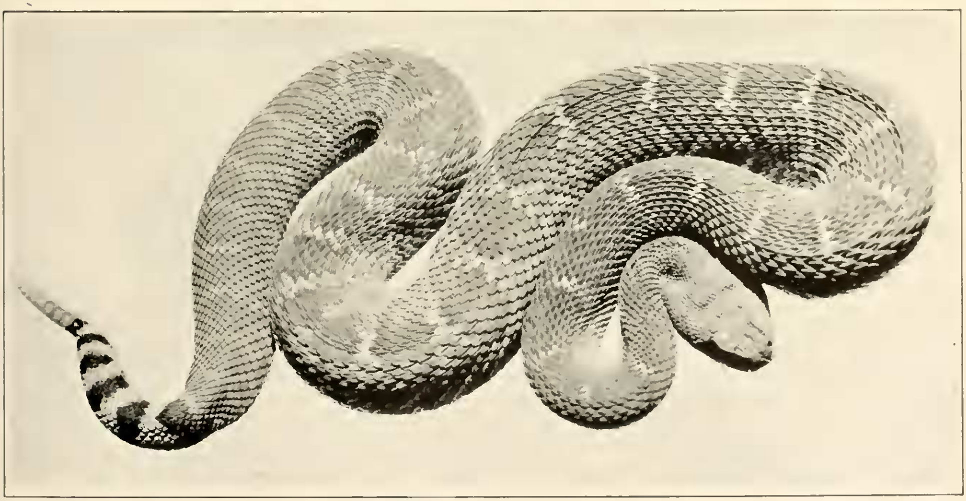

Fig. 83. *Crotalus ruber.*
Red Diamond Rattlesnake (22a).
(Specimen from Santa Margarita, San Diego County, California).

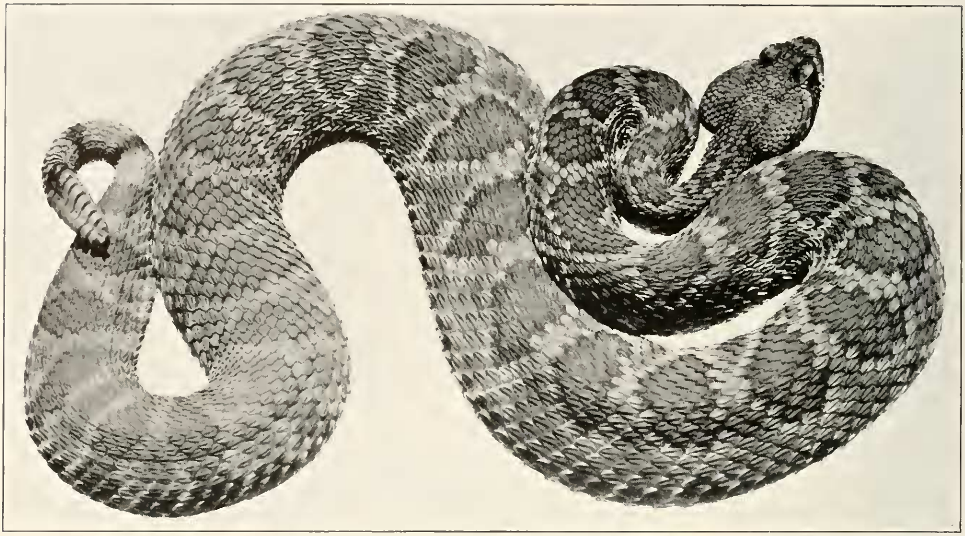

Fig. 84. *Crotalus scutulatus.*
Mohave Rattlesnake (18b).
(Specimen from Date, Yavapai County, Arizona).

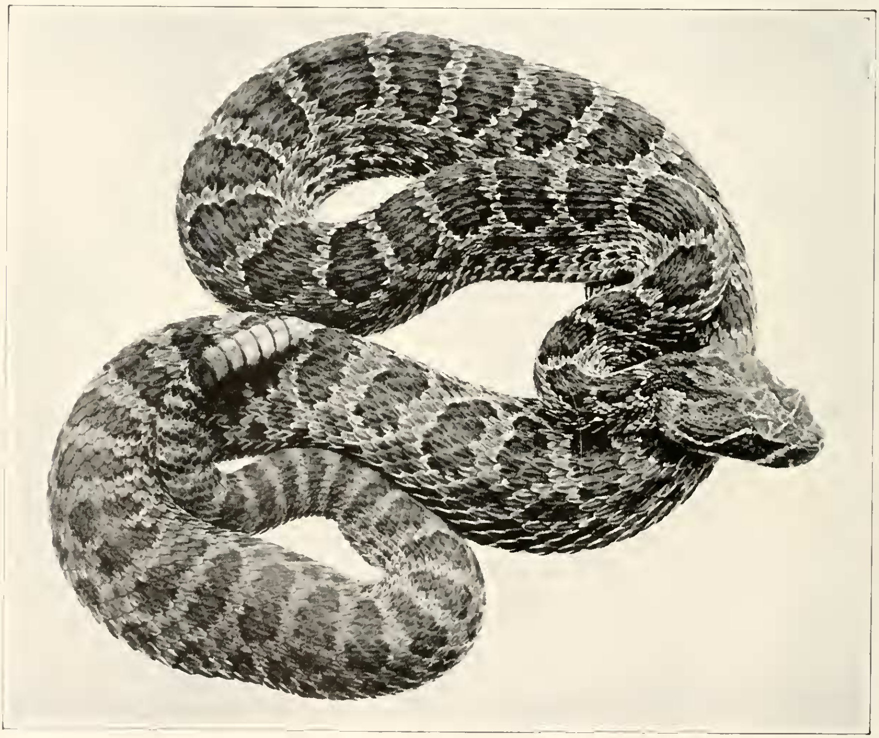

Fig. 85. *Crotalus viridis viridis.*
Prairie Rattlesnake (25a).
(Specimen from near Jetmore, Hodgeman County, Kansas).

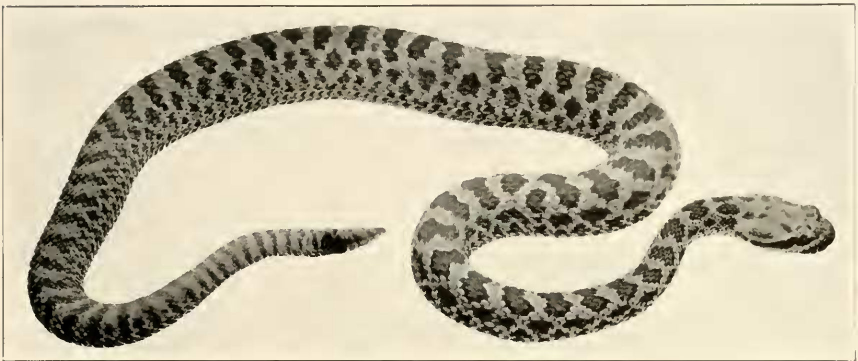

Fig. 86. *Crotalus viridis nuntius.*
Arizona Prairie Rattlesnake (25b).
(Specimen from Canyon Padre, Coconino County, Arizona).

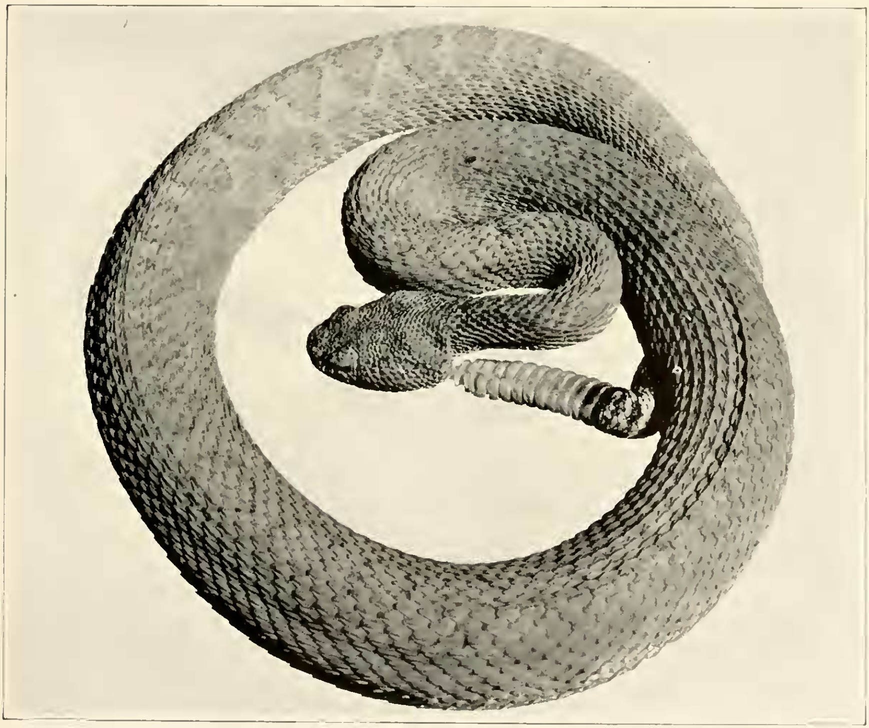

Fig. 87. *Crotalus viridis abyssus.*
Grand Canyon Rattlesnake (27b).
(Specimen from Tanner Trail in Grand Canyon, Coconino County, Arizona).

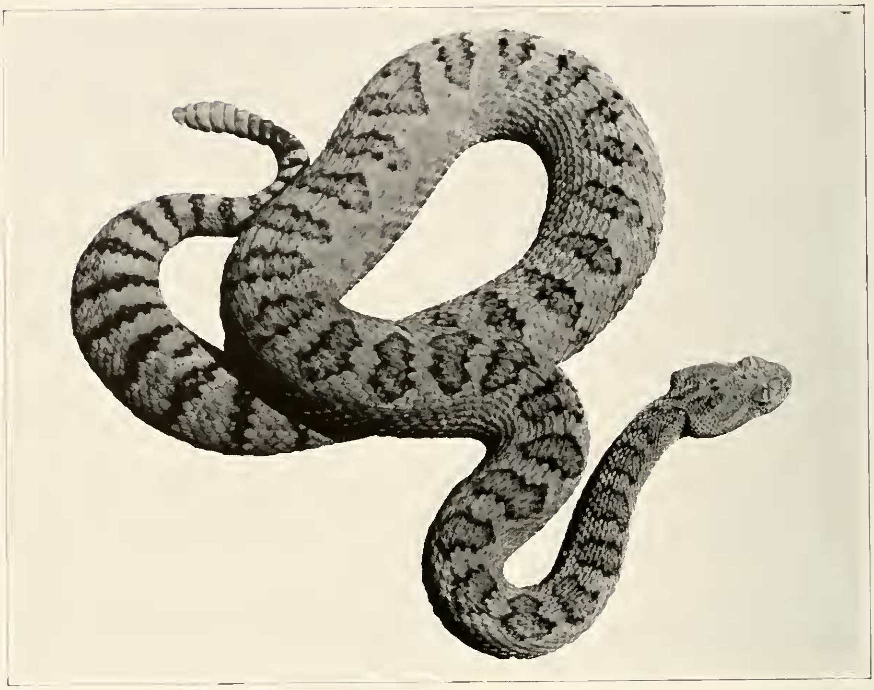

Fig. 88. *Crotalus viridis lutosus.*
Great Basin Rattlesnake (28a).
(Specimen from near Delta, Millard County, Utah).

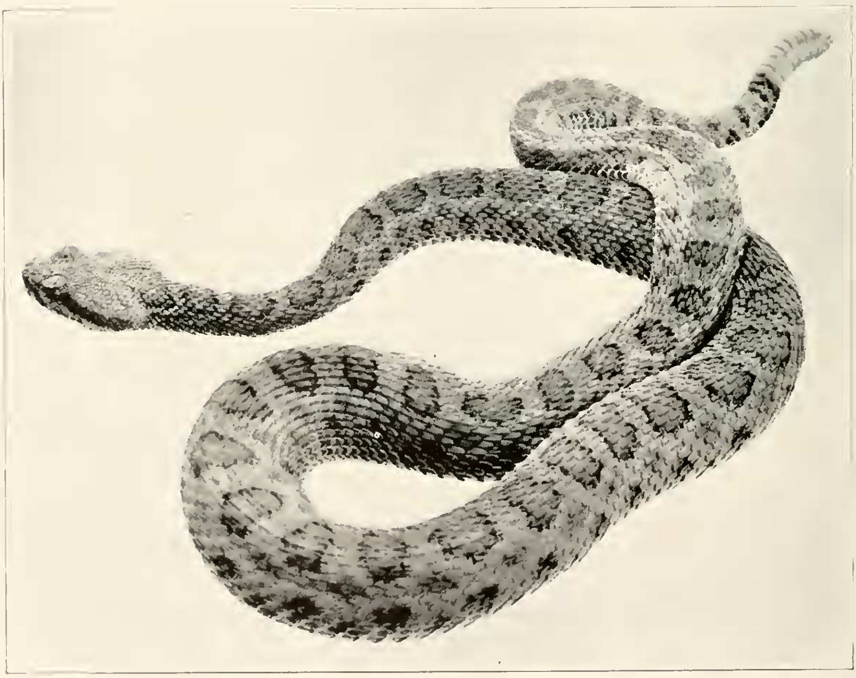

Fig. 89. *Crotalus viridis concolor.*
Midget Faded Rattlesnake (26b).
(Specimen from Jensen, Uintah County, Utah).

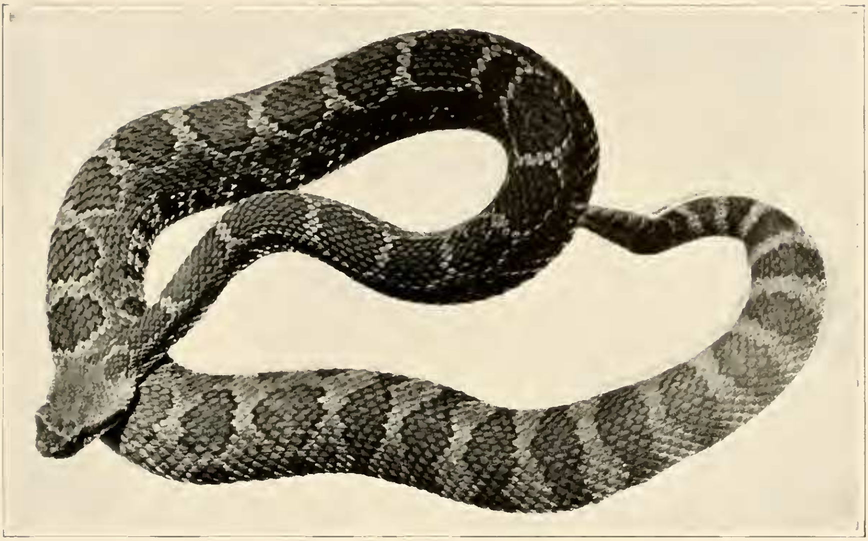

Fig. 90. *Crotalus viridis oreganus.*
Pacific Rattlesnake (28b).
(Specimen from near Wenatchee, Chelan County, Washington).

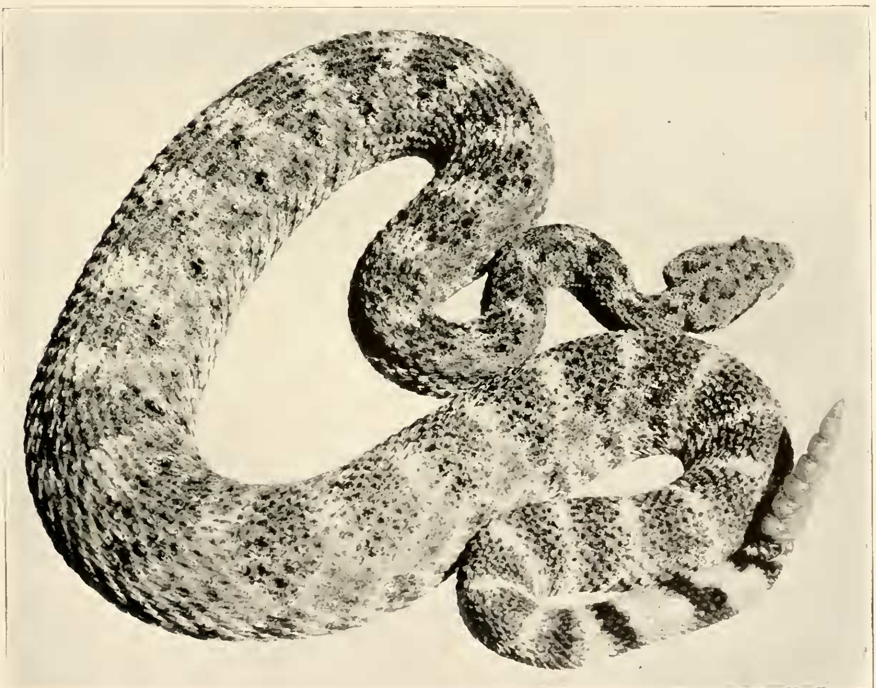

Fig. 91. *Crotalus mitchellii mitchellii.*
San Lucan Speckled Rattlesnake (16a).
(Specimen from La Rivera, Baja California, Mexico).

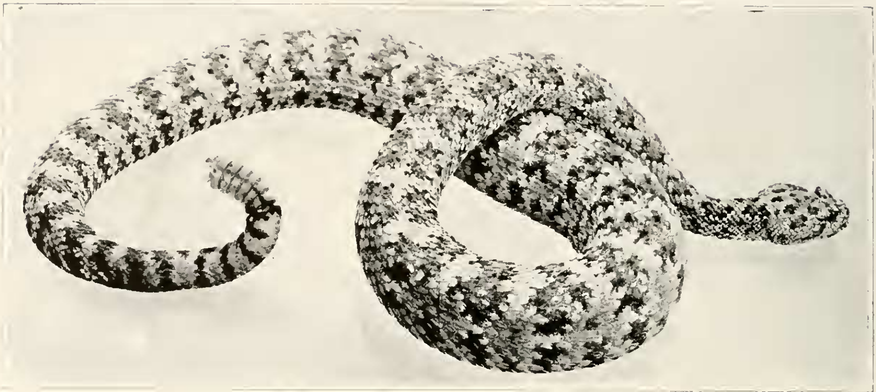

Fig. 92. *Crotalus mitchellii pyrrhus.*
Southwestern Speckled Rattlesnake (16b).
(Specimen from Yaqui Well, San Diego County, California).

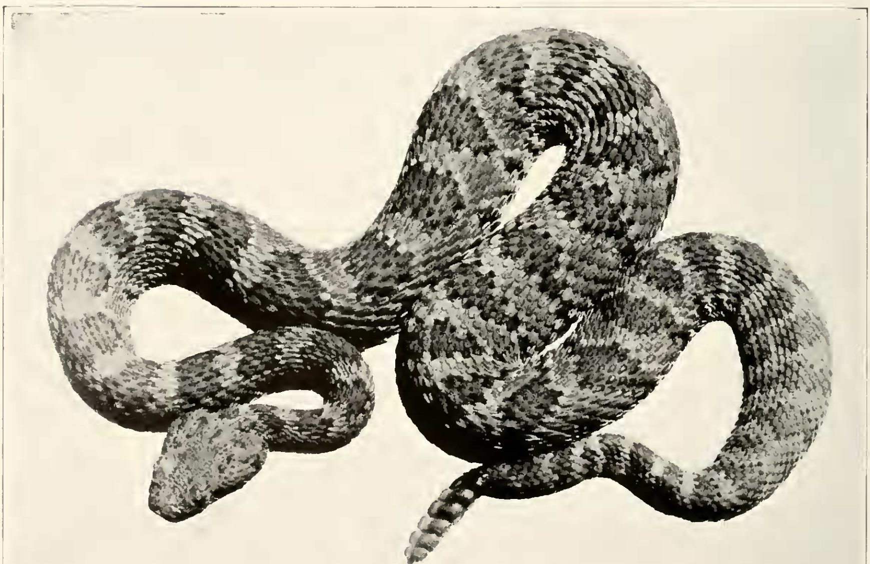

Fig. 93. *Crotalus mitchellii stephensi.*
Panamint Rattlesnake (30b).
(Specimen from near Aberdeen, Inyo County, California).

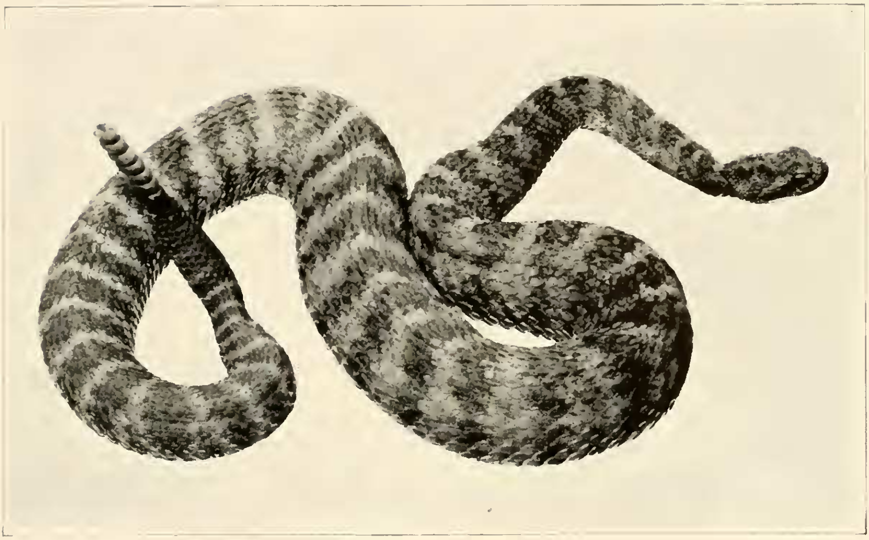

Fig. 94. *Crotalus tigris.*
Tiger Rattlesnake (33b).
(Specimen from Squaw Peak, Maricopa County, Arizona).

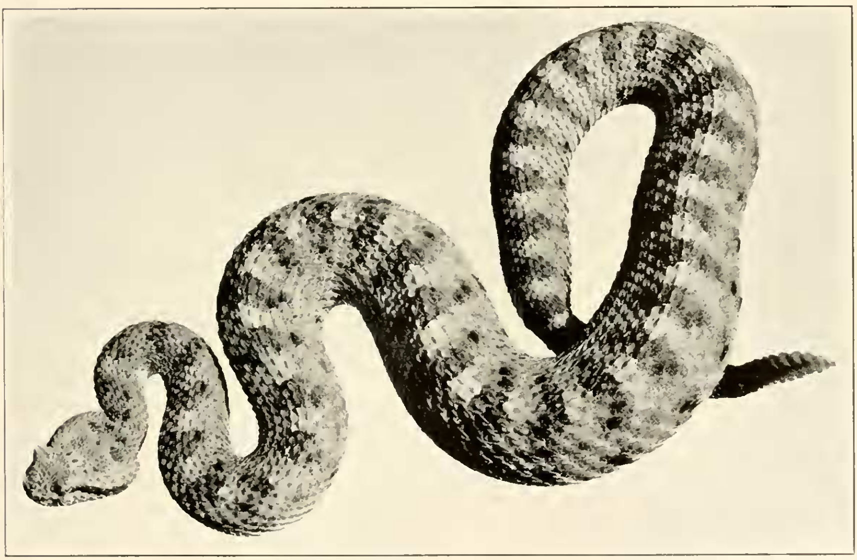

Fig. 95. *Crotalus cerastes.*
Horned Rattlesnake or Sidewinder (8b).
(Specimen from Borego Valley, San Diego County, California).

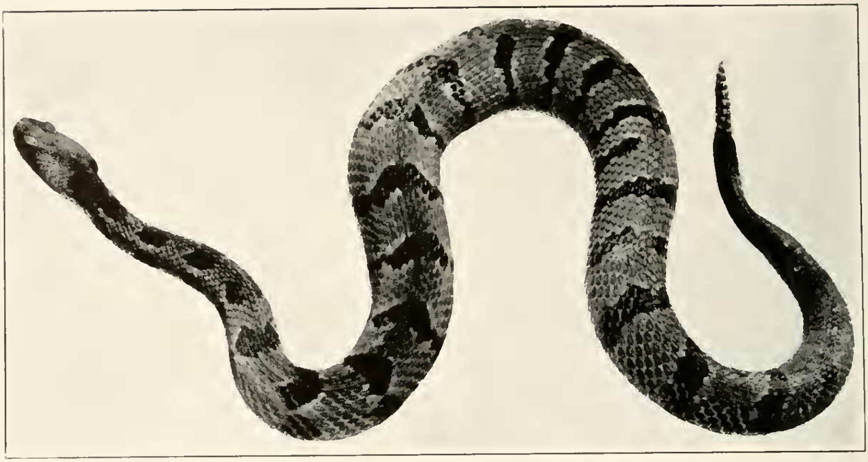

Fig. 96. *Crotalus horridus horridus.*
Timber Rattlesnake (35a).
(Specimen from near Baraboo, Sauk County, Wisconsin).

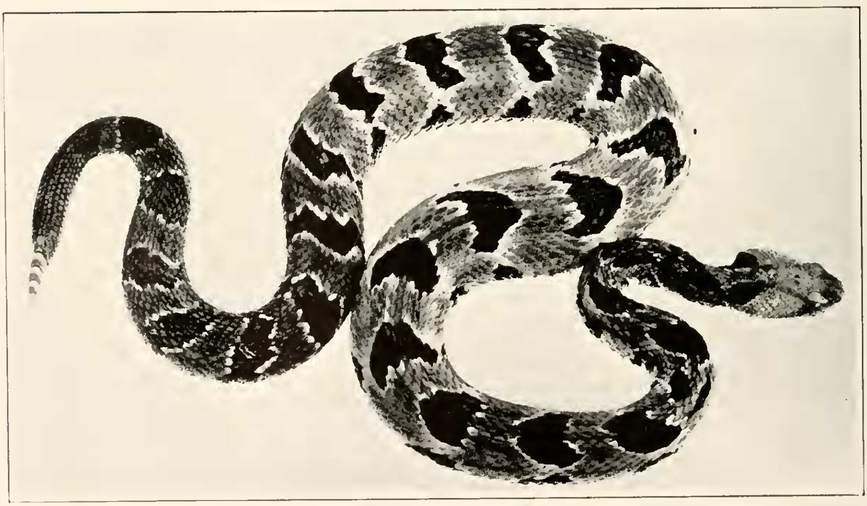

Fig. 97. *Crotalus horridus atricaudatus.*
Canebrake Rattlesnake (35b).
(Specimen from Imboden, Lawrence County, Arkansas).

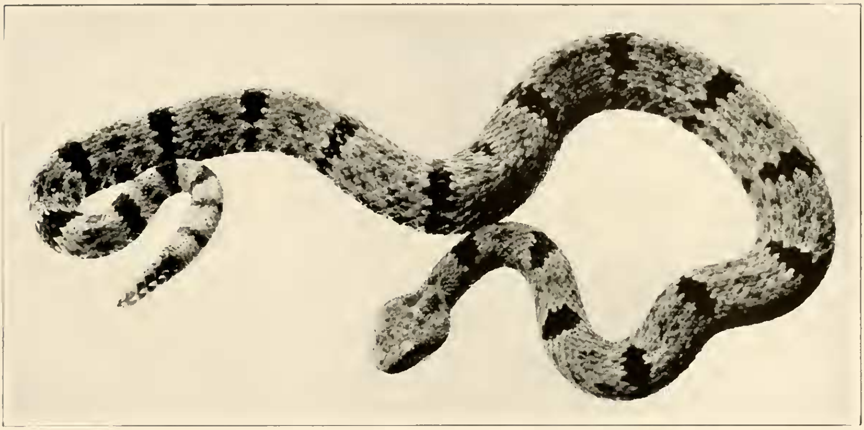

Fig. 98. *Crotalus lepidus lepidus.*
Eastern Rock Rattlesnake (14a).
(Specimen from Mt. Locke, Jeff Davis County, Texas).

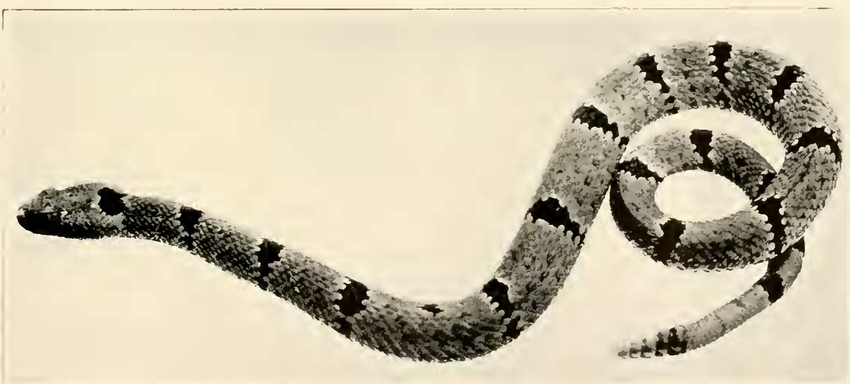

Fig. 99. *Crotalus lepidus klauberi.*
Green Rock Rattlesnake (14b).
(Specimen from Pinos Altos Mts., Grant County, New Mexico).

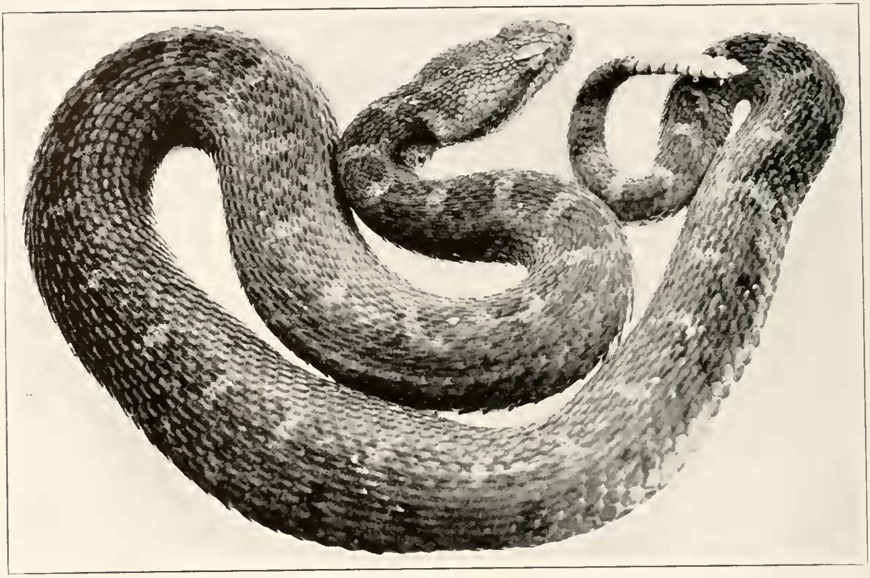

Fig. 100. *Crotalus triseriatus triseriatus.*
Mexican Spotted Rattlesnake (37a).
(Specimen from Jacala, Hidalgo, Mexico).

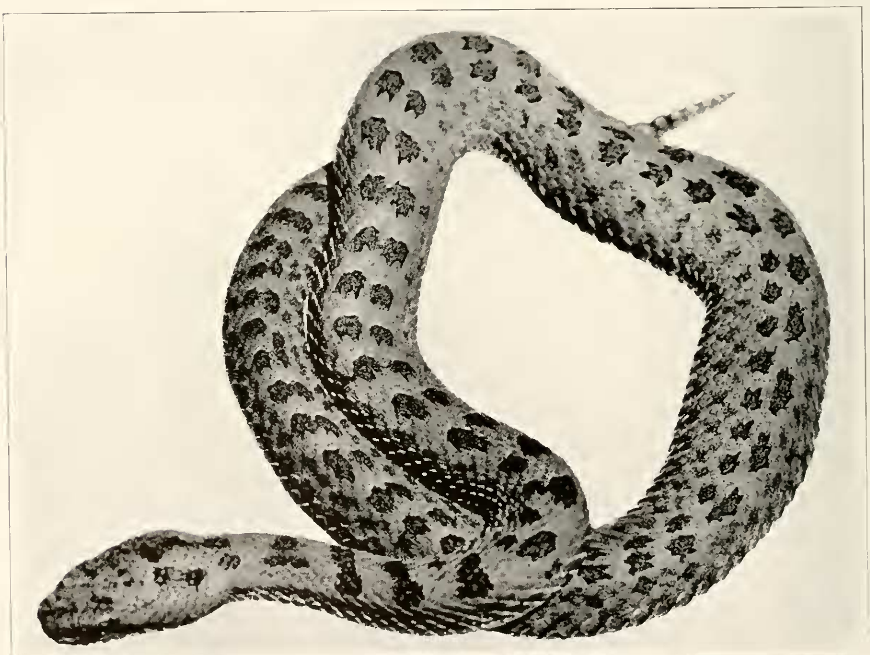

Fig. 101. *Crotalus triseriatus pricei.*
Arizona Spotted Rattlesnake (37b).
(Specimen from Ramsey Canyon, Huachuca Mts., Cochise County, Arizona).

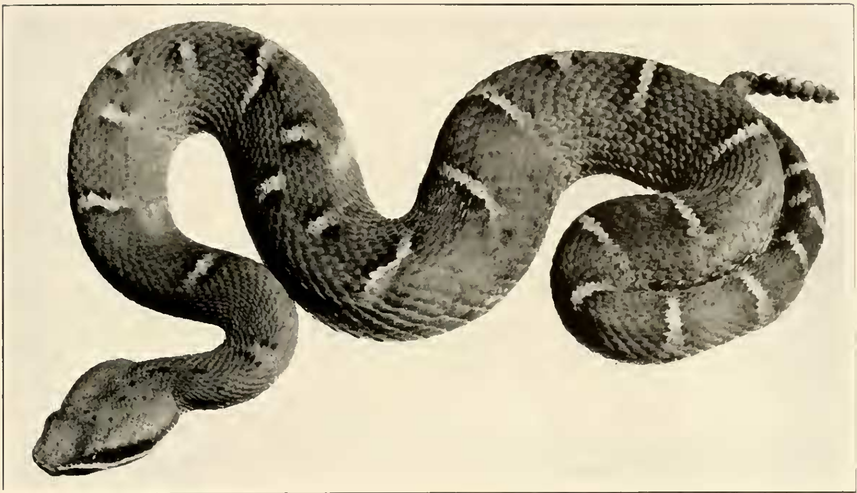

Fig. 102. *Crotalus willardi.*
Ridge-nosed Rattlesnake (9b).
(Specimen from Ramsey Canyon, Huachuca Mts., Cochise County, Arizona).

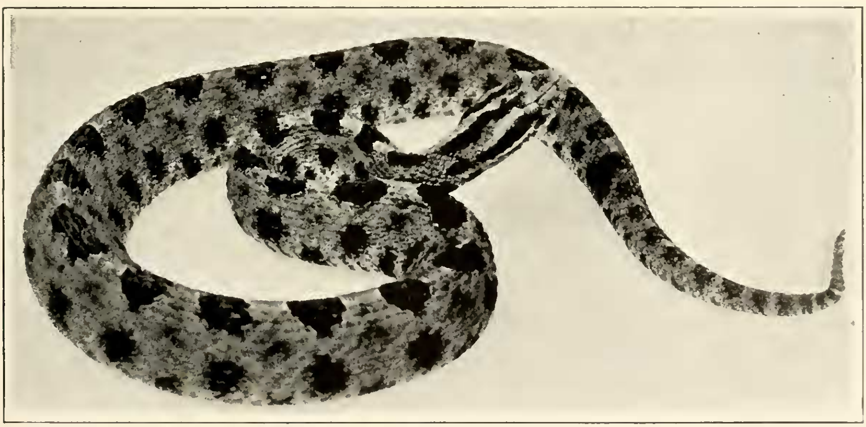

Fig. 103. *Sistrurus miliarius miliarius.*
Carolina Ground Rattlesnake (6b).
(Specimen from Leesville, South Carolina. Photo by courtesy of Howard K. Gloyd).

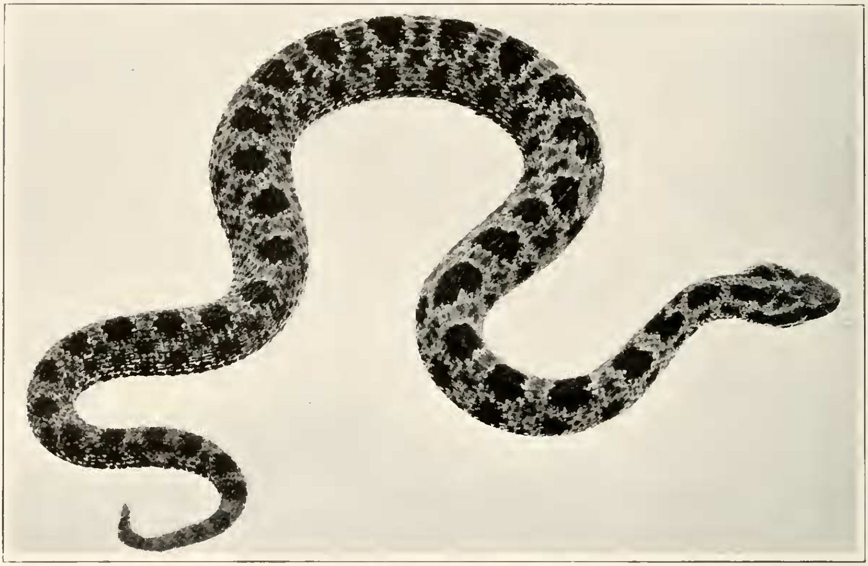

Fig. 104. *Sistrurus miliarius barbouri.*
Southeastern Ground Rattlesnake (5b).
(Specimen from Marion County, Florida).

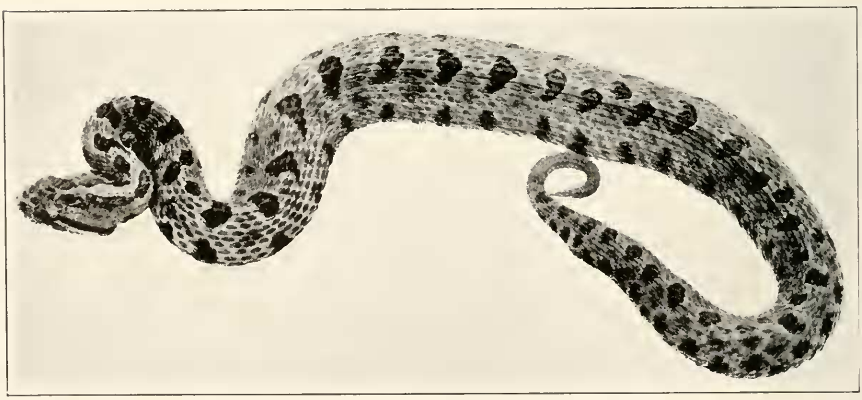

Fig. 105. *Sistrurus miliarius streckeri.*
Western Ground Rattlesnake (6a).
(Specimen from Gentilly, Orleans Parish, Louisiana).

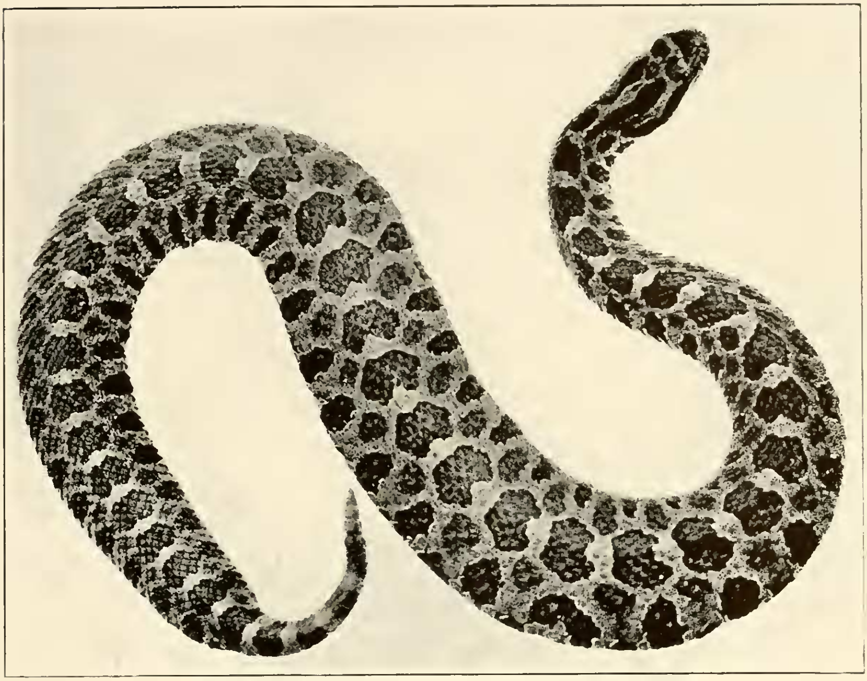

Fig. 106. *Sistrurus catenatus catenatus.*
Eastern Massasauga (4a).
(Specimen from Proud Lake, Oakland County, Michigan. The flattened posture is one often assumed by an angered rattler).

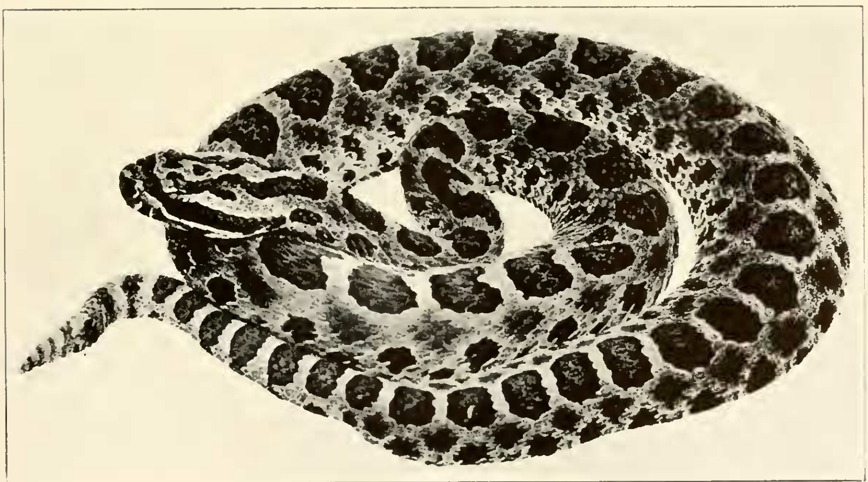

Fig. 107. *Sistrurus catenatus tergeminus.*
Western Massasauga (4b).
(Specimen from China Spring, McLennan County, Texas).

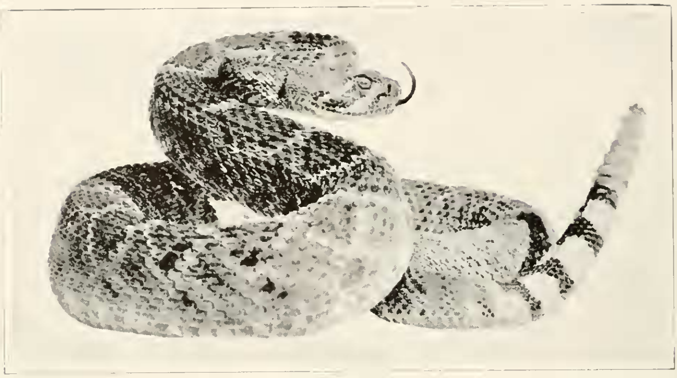

Fig. 108. A rattlesnake in a striking coil or typical defensive posture.
(*Crotalus cinereous,* Western Diamond Rattlesnake, Riverside County, California).

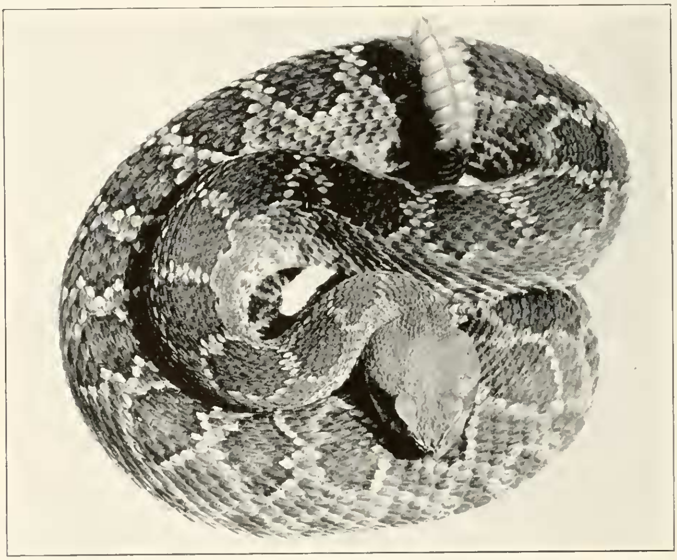

Fig. 109. A rattlesnake in its resting coil.
(*Crotalus viridis oreganus,* Pacific Rattlesnake, San Diego County, California).

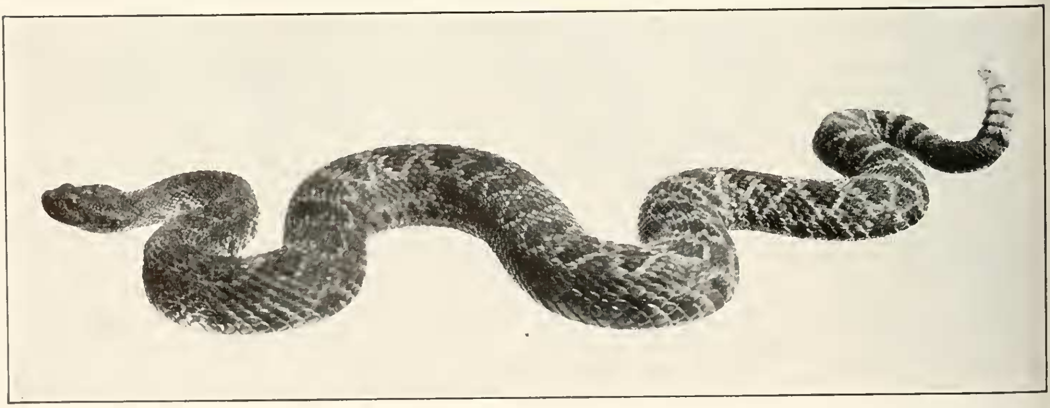

Fig. 110. A rattlesnake crawling; note how the rattle is elevated to prevent dragging.
(*Crotalus viridis oreganus,* Pacific Rattlesnake, San Diego County, California).